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OPERATOR'S MANUAL

TM-103062

MODEL K103 TEST KIT

AND

MODEL 604A DISTURBANCE SIMULATOR

DRANETZ

MP MASTER
MA23005

ME-8966

WARNING

Because of possible shock or fire hazards, connection to this instrument should be performed in compliance with the National Electrical Code (ANSI C1) and/or any other requirements which may be applicable to the user.

Installation, operation, and maintenance should be performed only by qualified personnel.

1 January 1980

Revision A

OPERATOR'S MANUAL

TM-103062

MODEL K103 TEST KIT

AND

MODEL 604A DISTURBANCE SIMULATOR

NOTE

Refer to Volume 2 (Service Manual) of TM-102700 for supplemental information.

This equipment is manufactured under U.S. Patent Number 3,549,874 - Dranetz Eng. Labs., Inc. 23207

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SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION

This manual is a supplement to TM-102700 (Operator's Manual and Service Manual for the Series 606 Power Line Disturbance Analyzer). Together, these manuals provide complete operating and maintenance instructions for the Model K103 Test Kit and the Model 604A Disturbance Simulator (hereinafter referred to as the Simulator), manufactured by Dranetz Engineering Laboratories, Incorporated, South Plainfield, New Jersey. This section describes the purpose, application, and technical characteristics of the Test Kit and the Simulator.

1-2. PURPOSE

The Simulator is a compact, portable, calibrated disturbance simulator that operates from the single-phase power line (115/230V, 50/60Hz. nominal), and produces three 2-wire outputs that simulate sags, surges, impulses, and slow variations in AC voltage. It is used to implement rapid performance verification of any Model 606 in the field or on the test bench.

The Model K103 Test Kit (which includes the Simulator) comprises all the equipment normally required (except for general purpose meters and an oscilloscope) for comprehensive checkout, as well as troubleshooting, repair, and recalibration, of any Model 606 Power Line Disturbance Analyzer.

1-3. EQUIPMENT CHARACTERISTICS

The following items of equipment are included in the Model K103 Test Kit:

a. Model 604A Line Disturbance Simulator (described in paragraph 1-2.)

b. Test and Calibration ROM (Ident No. 026U26, P/N 105026). This ROM permits the user to select the Analyzer measurement functions and detectors individually. It is to be used with any Model 606 containing a CPU A3 Board identified as P/N 103120-G2 or 102720. (See Table 1-1.) Refer to Section V of TM-102700 for a detailed description of the purpose and operation of this ROM.

c. Test and Calibration ROM (Ident No. 036U26, P/N 105036). This ROM permits the user to select the Analyzer measurement functions and detectors individually. It is to be used with any Model 606 containing an A3 Board identified as P/N 103120-G1 or 106630-G1. (See Table 1-1.) Refer to Section V of TM-102700 for a detailed description of the purpose and operation of this ROM.

Table 1-1. ROM Selection Guide

A3 Board (CPU)	RAM Test ROM		Test and Calibration ROM	
	Ident No.	D.E.L. Part No.	Ident No.	D.E.L. Part No.
P/N 102720	028, U26	105028	026, U26	105026
P/N 103120-G2	028, U26	105028	026, U26	105026
P/N 103120-G1	035, U26	105035	036, U26	105036
P/N 106630-G1	035, U26	105035	036, U26	105036

A3 Board (CPU)	Printer Test ROM	
	Ident No.	D.E.L. Part No.
P/N 102720	027, U26	105027 A B or C
P/N 103120-G2	027, U26	105027 A B or C
P/N 103120-G1	027, U26	105027 A B or C
P/N 106630-G1	027, U26	105027 A B or C

A5 Printer Type	ROM Type
A5 P/N 102730	027A or B, U26 105027A, B or C
A5 P/N 103600	027C, U26 105027C

d. Printer Test ROM (Ident No. 027U26, P/N 105027). This ROM is used to localize the cause of Analyzer malfunctions to either a faulty CPU Board A3 or to a faulty printer. Since CPU Board A3 is the major controlling element of the Analyzer, oscilloscope waveform analysis may also be required to enable this determination. Refer to Section V of TM-102700 for a detailed description of the purpose and operation of this ROM.

e. Version 027C of the Printer Test ROM eliminates the "Busy Signal Too Short" test which allows the printing of the normal test message with the DEL P/N 103600 Printer Assembly.

When testing a unit which uses the DEL P/N 102730 Printer (A5) Assembly, the Busy signal must be verified by measurement in accordance with TM-102700.

f. RAM Test ROM (Ident No. 028U26, P/N 105028). This ROM tests the Random Access Memory (RAM) of CPU Board A3 and prints out the status with identification of each RAM circuit chip. Provision is included for

repetitive testing with an audio alarm activated when a defective chip is located. This ROM is to be used with any Model 606 containing an A3 board identified as P/N 103120-G2 or 102720. Refer to Section V of TM-102700 for a detailed description of the purpose and operation of this ROM.

g. RAM Test ROM (Ident No. 035U26, P/N 105035). This ROM tests the Random Access Memory (RAM) of CPU Board A3 and prints out the status with identification of each RAM circuit chip. Provision is included for repetitive testing with an audio alarm activated when a defective chip is located. This ROM is to be used with any Model 606 containing an A3 board identified as P/N 103120-G1 or 106630-G1. Refer to Section V of TM-102700 for a detailed description of the purpose and operation of this ROM.

h. A3 (CPU) Board P/N 106630-G1 uses different RAM IC chips from P/N 103120. To maintain compatability, RAM identification U20 thru U23 refers to U20, data bits 0 thru 3. U19 identification is not affected.

i. Card Puller (P/N 103064). The card puller simplifies removal of major plug-in cards.

j. Extender Card (P/N 102677). This card permits major plug-in cards to be operated outside of the card rack, facilitating calibration and troubleshooting.

k. Extender Cable Set (P/N 103060 and P/N 103061). The Cable Set permits extended card operation of Analyzers equipped with Option 101.

Revision Data

Revision to TM-103062, Operator's Manual
Model K103 Test Kit

In paragraph 1-3:

1) Printer Test ROM P/N 105027 has been revised to Rev. C. This change eliminates the "Printer Busy Too Short" test to facilitate testing Dranetz Printer P/N 103600.

2) Test ROMs P/N 105026 and 105028 are no longer supplied with K103 kits since their use is limited to very early production 606's. If required, these parts are available for separate purchase through Customer Service.

3) For A3 board, P/N 107416, diagnostic ROM P/N 105079 is supplied in the K103 kit. This ROM contains software for printer test, RAM test and CPU tests.

1-4. ADDENDUM 1

This Addendum applies to all Series 606 and 616 Analyzers equipped with new CPU (A3) board P/N 107416. This new board adds the following features to the 606's and 616's:

1. Option 106 (RS232 Capability)
2. Channel A directivity for 616's (Option 105)
3. New DC voltage range for 616's (Model 616C).
4. A revised test/calibrate capability

1-5. CPU BOARD P/N 107416

The new CPU board is directly compatible with existing 606/616 mainframes. The master ROM on the CPU board now includes resident options that are enabled under software control as a function of the state of various jumpers and switches on this board.

Configuring the A3 Board

The jumpers and switches used to configure the A3 board appear on the assembly drawing of figure 1. Table 1 identifies the functions of these components.

Table 1. Functions of Jumpers and Switches

Item	Function
J3	Selects PROM/ROM for socket U23
J4	Selects PROM/ROM for socket U24
U23, U24	Memory sockets
J2	U23 and U24 address assignment jumpers
J5	Master ROM based, option enable jumpers
S1A	Selects 1Ø (for 606-1) or 3Ø (for 606-3)
S1B	Enables calibrate function

NOTE: Jumper J5 and switches S1A and S1B simply enable software. To enable an option, the appropriate optional hardware must be present in the system.

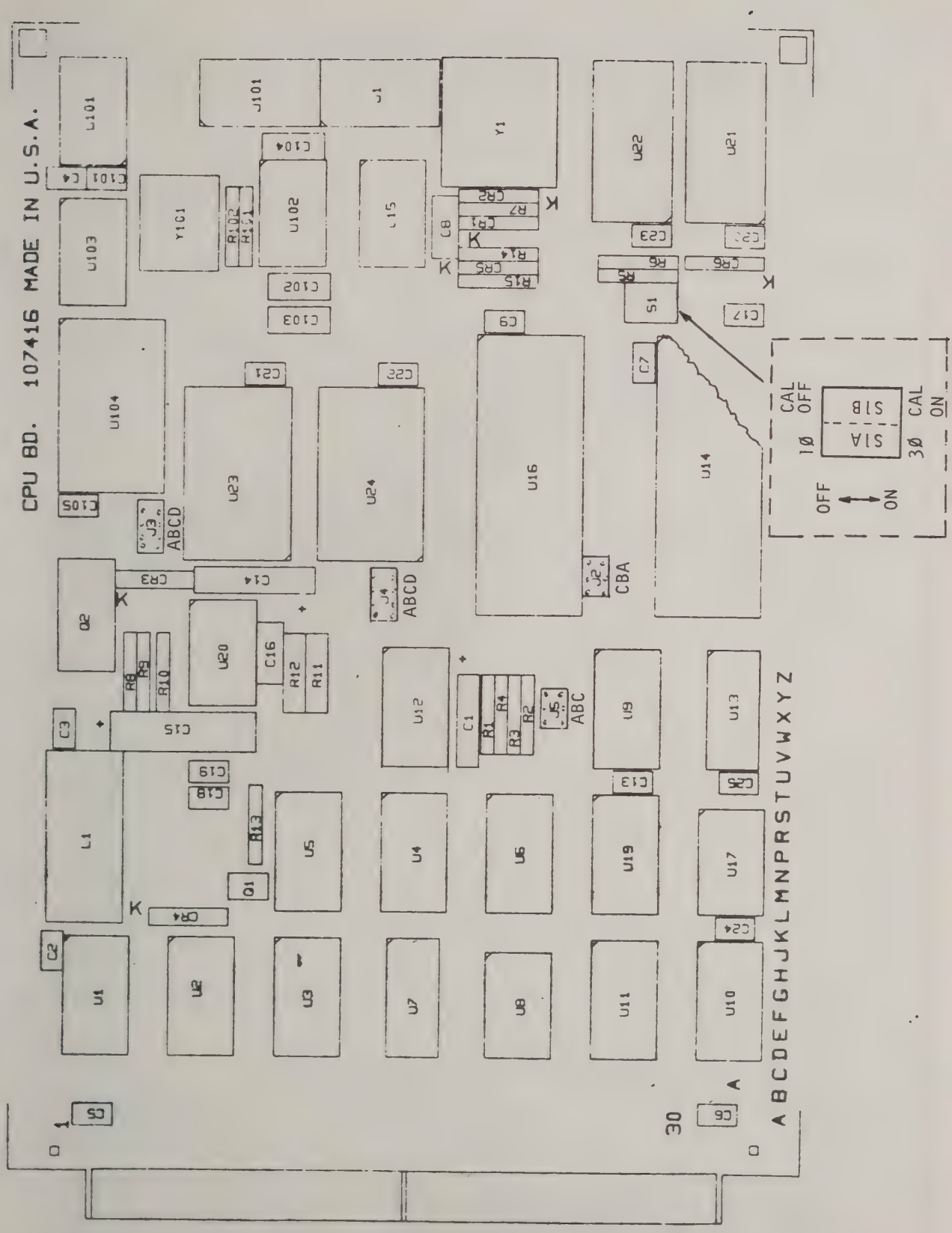


Figure 1. CPU Board, Assembly Drawing

Proper jumpering of J3 and J4 permits U23 or U24 to accept one of three different PROM ROM types, in conjunction with appropriate address assignments at J2. Table 2 summarizes the PROMs selected by jumpers J3 and J4.

Table 2. PROM Selection Summary, J3 and J4

	Jumper Position			
PROM type	A	B	C	D
2716 (Intel)	S	O	O	S
2732 (Intel)	O	S	O	S
2532 (T.I.)	S	O	S	O

where: J3 applies to U23
J4 applies to U24
S = Short or jumpered
O = Open or unjumpered

J2 contains the U23 and U24 address assignment jumpers. All 1-PROM 606/616's should be jumpered at J2-C. J2-B is the Options Enable position. All 606/616's requiring a ROM at U23 and U24 should be jumpered at J2-B. J2-A is not used. Table 3 summarizes the J2 jumpers.

NOTE: J2 must not be jumpered in more than one position simultaneously.

Table 3. J2 Jumper Codes

	Jumper Position		
	A	B	C
Standard 4K	O	O	S
Option Select	O	S	O
Not Used	S	O	O

Jumper bar J5 and switch S1 are used to enable the options resident in the standard master ROM at U24. Tables 4 and 5 show the options enabled by J5 and S1, respectively.

Table 4. Standard Options Enabled by J5

Option Enabled	Jumper Position	Equipment Required
RS232 (Option 106)	J5-A	RS232 Interface Hardware
Buffered RS232	J5-B*	Buffered RS232 terminals
Frequency Option 101	J5-C	Appropriate frequency counters

*This position is never jumpered alone. If used, J5-A must also be jumpered.

Table 5. Options Enabled by S1

Switch	Position	Option Enabled	Notes
S1A	OFF	606-1 Single Phase Unit	N/A for 616's
S1A	ON	606-3 3-Phase Unit	Always on for 616's. Requires necessary detectors for phases B and C for 606's
S1B	OFF	Operate mode	Normal position when not in calibrate mode.
S1B	ON	Calibrate mode	P/O K103 field service capability. Works for all 606/616's with any option. Refer to Section 5 of Service Manuals.

1-6. TEST/CALIBRATE FUNCTION

The calibrate function of the new A3 board is virtually identical to the function provided by the Test and Calibration ROM provided for previous 606's and 616's. (Refer to Section V of the corresponding service manuals: TM-102700 and TM-103140, respectively). However, the calibrate function is now resident in the master ROM on the new A3 board. This resident capability, along with the new K103 Test ROM (P/N 105079), constitutes the complete software package for the K103 Field Service Test Kit.

Enabling the 606/616 Calibrate Software

a. Turn off the instrument and remove the A3 board, being careful not to damage the ribbon cable if the unit is equipped with Option 101.

b. Referring to figure 1, set dip switch S1B to the ON (CALIBRATE) position.

c. Reinstall the A3 board. If one wishes to use an extender board, an extender cable will be required for Option 101 units.

d. The calibration function is now enabled. Turn on the instrument and follow the instructions given in Section V of the appropriate Service Manual.

Test and Calibration

As for previous 606/616 versions, the software allows the user to select a detector and print the voltage at that detector, using the standard fault message formats. The SLOW AVG threshold switch is used as the threshold select switch; the SAG/SURGE threshold switch is used as the phase or channel selector. Using these two switches, any detector can be selected and its contents printed.

In the case of the average and cycle detectors, the user can generate a continuous display by leaving the PRINT pushbutton turned on. A display can be generated on demand by depressing the PRINT pushbutton off and depressing the TEST pushbutton. For display of the frequency and impulse detectors, the PRINT pushbutton must be on and the user must have a means of generating valid faults (e.g., by using the 604A).

Table 5-3 in the 606/616 Service Manuals summarizes the selector positions and the associated displays in detail. Table 6 below summarizes the calibrate function. Note that references to sag, surge, average, impulse and frequency refer to the type of fault message used to display the detector values.

Table 6. Calibrate Detector Selection Summary*

Detector Selector Position	Phase Selector Position (SAG/SURGE Threshold Switch)			
	Phase A	Phase B	Phase C	Freq. Only
1	PHASE A CYCLE 1 SURGE	PHASE B CYCLE 1 SURGE	PHASE C CYCLE 1 SURGE	NA NA RESET
2	PHASE A AVERAGE AVG	PHASE B AVERAGE AVG	PHASE C AVERAGE AVG	NA NA RESET
3	PHASE A CYCLE 2 SAG	PHASE B CYCLE 2 SAG	PHASE C CYCLE 2 SAG	NA NA RESET
4	PHASE A IMPULSE IMPULSE	PHASE B IMPULSE IMPULSE	PHASE C IMPULSE IMPULSE	NA FREQ COUNTERS FREQ

*The first entry in each box refers to the phase, the second refers to the type of detector and the third refers to the type of fault message used for the printout. Sag/surge messages will generate 0 cycles. Attempts to access phases B and C on 606-1 units will result in reset messages. The selector position numbers are referenced from the fully counter clockwise position. Actual fault message formats will vary slightly for differently optioned units. Refer to Section V of the Service Manuals for details on specific adjustments required to bring the unit into calibration.

1-7. K103 TEST ROM (P/N 105079)

The test program resides on a 2K byte Intel 2716 type PROM. This software provides for four test functions which can be run either continuously or in a stepwise fashion by proper use of the PRINT and TEST pushbuttons. Each test function is selectable using the SLOW AVG threshold switch as a test select switch. The tests are summarized in Table 7. The single K103 Test PROM applies to all 606/616 units.

Table 7. K103 Test Summary

Test Selector Position	Test Selected	Notes
1	Printer Test	Activated on power up or on position 1.
2	Test all	Performs all tests (3,4,1 in that order) and also exercises the CPU. If the RAM test fails, tests 1 and 4 will be aborted.
3	RAM test	Exercises RAM chips U21 and U22 with a computer pattern. Test lasts approx. 4 seconds. If the test fails, the alarm rings and the defective chip(s) are printed out.
4	Print all ports	Reads the 12 (0-B hex) internal ports through which the CPU board communicates with the outside world and prints the contents in binary form.

Using the K103 Test ROM

Although the test ROM is designed to operate in either socket U23 or U24 on the A3 board, it is generally more convenient to run it in socket U23. It is then handled as if the test ROM is any other software option. To run the ROM in U23, observe the following constraints:

1) U24 must contain the 606/616 master ROM.

2) U23 must be jumpered at J3 to accept a 2716.

3) J2-B must be jumpered.

CPU (A3) boards with U23-based options simply require the removal of the option PROM and insertion of the test ROM. Non-option units normally simply require moving the J2 jumper from C to B and inserting the test ROM into U23. To run the test ROM in U24, observe the following constraints:

1) U24 must be jumpered at J4 to accept a 2716.

2) J2-C must be jumpered.

Before powering up the test program, the ALARM pushbutton should be on. The PRINT pushbutton may be either on or off, as desired. After turning on the unit, a 2-3 second delay will allow the hardware to settle and the alarm will sound to let the operator know that power up and minimum CPU board function has been achieved. At this point, the software prints out the printer test message. This verifies CPU and printer function immediately and unconditionally because proper operation of the other tests depend on the CPU and the printer.

At this point, the software enters the test control loop which determines which test has been selected and when to execute the test. All test functions eventually return to this loop. If the PRINT pushbutton is OFF, the program checks the on/off status of the TEST pushbutton. If the TEST pushbutton is on, the selected test function is executed; if off, the unit waits until either TEST or PRINT is depressed. Thus, the user can continuously execute a test by leaving the PRINT pushbutton on, or selectively execute tests by turning off the PRINT pushbutton, selecting a test, and depressing the TEST pushbutton.

K103 Printer Test

This test verifies printer operation by printing a fuel character set test sequence:

```
PQRSTUVWXYZ[\]↑←
@ABCDEFGHIJKLMNO
0123456789:;<=>?
 !"#$%&'()*+,-./
```

Upon power on, or when the printer test is completed as part of the "test all" sequence, the message

K103 TEST ROM

prefaces the printer test sequence. By inspection, the user can determine if a printer malfunction exists.

The printer test monitors the print "busy" line to insure that the software does not hang up in a "busy/wait" loop. If the busy signal remains high for more than 23 milliseconds, the software assumes the line is hung up and attempts to force the following diagnostic message:

PRINT BUSY TOO LONG

When the test/diagnostic message ends, the program returns to the test control loop. If the printer test fails, the fault must be remedied before testing can be resumed.

K103 RAM Test

The RAM resides at U21 and U22. The CPU tests RAM by repeatedly sending test patterns to these chips and verifying the results. If the RAM test succeeds, the unit prints RAM TEST PASSED and the program returns to the test control loop. If the RAM test fails, the unit sounds the alarm, determines which chip is faulty and prints one or both of the following:

RAM U21 FAILED

(and/or)

RAM U22 FAILED

The RAM test should be performed in the continuous mode because certain RAM failures/problems may not be detected in one test. Twenty tests should be performed to detect marginal problems.

Print All Ports Test

During this test, each internal CPU board port is read and its 4-bit binary contents is printed. This test should not be performed unless both the printer and RAM check out because it depends on both of these components to function properly. The test can be used to exercise the "port read" function and to verify the contents of certain ports.

The information is printed in the following format:

"PORT # 0X XXXX"

The port number ranges between 00 and 0B hex. The 4-digit binary number that follows the port number represents the state of each of the four input lines at each port. This test is included as an aid in testing and debugging the mainframe and is primarily intended for a skilled technician familiar with the operation of the unit.

Test All Function And CPU Test

The "test all" function performs each of the tests plus a CPU test. The CPU test software executes instructions and instruction types that haven't been used previously in the test software. Instructions previously exercised are implicitly assumed to be operating properly. The CPU test extensively exercises the CPU to build confidence in its operation. Successful execution produces a "CPU OKAY" message. If the CPU test fails, the unit reacts in one of the following ways:

1) It prints "CPU ERROR."

2) It ceases operation completely.

3) It resets itself and continues to operate but fails to print the "CPU OKAY" message.

The "test all" function executes the tests in the following order:

1) RAM test.

NOTE: If the RAM test fails, all other tests will be aborted and control returns to the test control loop.

2) Print all ports test

3) CPU test

4) Re-execution of the power up sequence and the printer test

5) Return to test control

SECTION II

OPERATION

2-1. GENERAL

This section contains the basic operating procedures for the Simulator. The functions of all operating controls are described in detail. For operating information on all other items contained within the Model K103 Test Kit, refer to Section V of TM-102700 (Service Manual for the Series 606 Power Line Disturbance Analyzer).

2-2. OPERATING CONTROLS

The functions of all top panel operating controls are presented in Table 2-1. All referenced items are shown in figure 2-1.

Table 2-1. Operating Controls

Index No.	Controls	Function
1	Nominal Input Switch	Slide switch position determines proper single phase input voltage (either 115 or 230V RMS).
2	PHASE Selector Switch	Three position switch determines which output phase is to be affected by disturbance controls.
3	ON/OFF Switch	ON Position: Applies power to Simulator. OFF Position: Power off.
4	NORM/IMP CAL Switch	NORM Position: AC voltage appears on three output phases. IMP CAL Position: Removes AC line voltage from the outputs to permit observation of impulse amplitude.
5	AVG Knob	Determines output voltage (percentage of input voltage) on selected phase.

Table 2-1. Operating Controls (Cont'd.)

Index No.	Controls	Function
6	SAG Knob and Pushbutton	Knob determines output voltage decrease (percentage of input voltage) which is applied to steady-state voltage on selected phase when pushbutton switch is depressed. Duration limited to a maximum of approximately 16 cycles.
7	SURGE Knob and Pushbutton	Knob determines output voltage increase (percentage of input voltage) which is applied to the steady-state voltage on selected phase when pushbutton switch is depressed. Duration limited to a maximum of approximately 16 cycles.
8	IMPULSE Knob and Pushbutton	Knob determines peak impulse voltage which is applied to the selected phase when pushbutton is depressed.

2-3. CONNECTION INSTRUCTIONS

For detailed connection instructions, refer to paragraph 3-4 of TM-102700.

2-4. OPERATION

Refer to Sections III and V of TM-102700 for operating instructions.

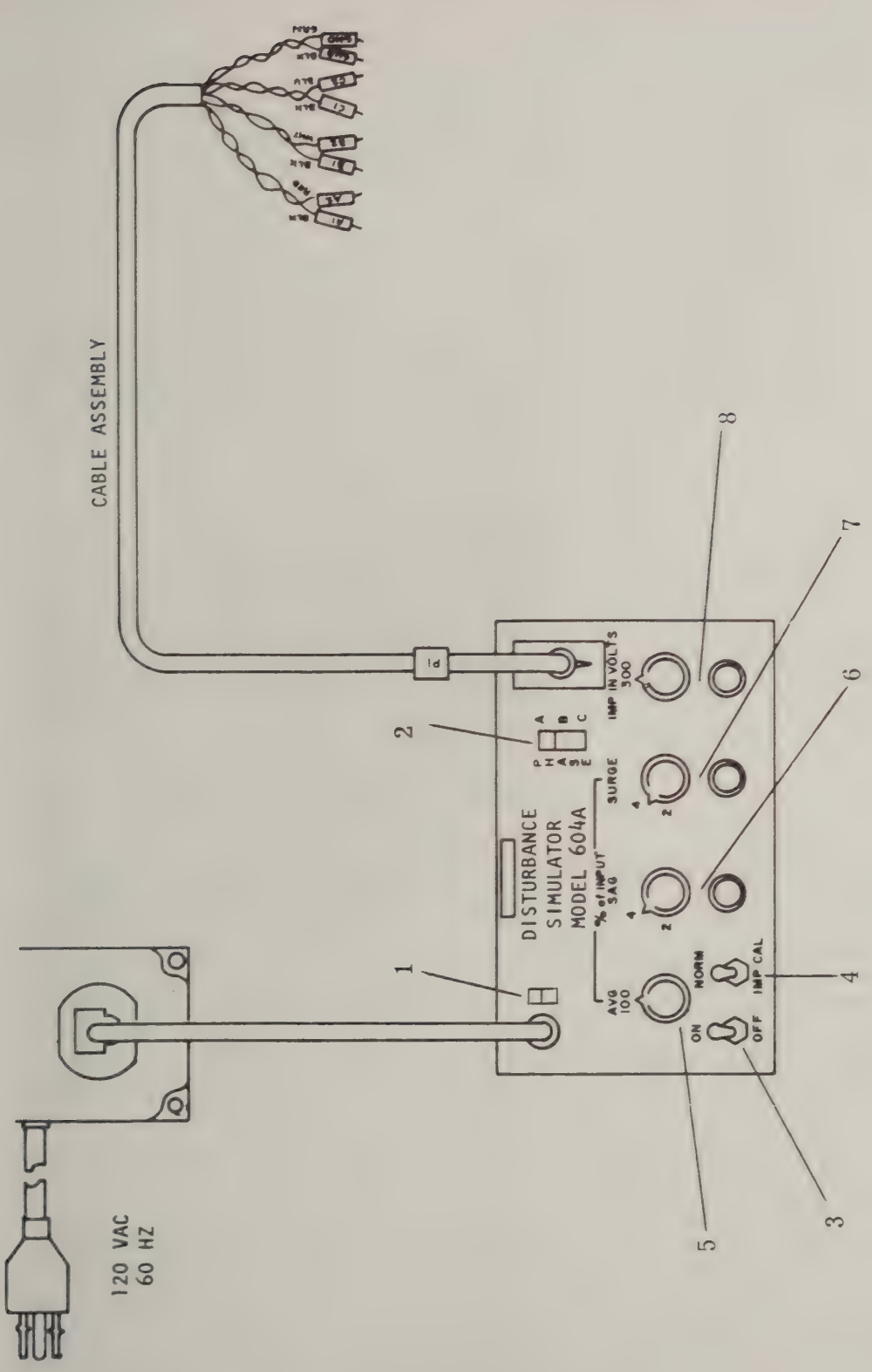


Figure 2-1. Model 604A Operating Controls

SECTION III

THEORY OF OPERATION

3-1. INTRODUCTION

This section provides a functional description of the Model 604A Simulator. The discussion is referenced to figures 3-1 and 6-1. Refer to Section V of TM-102700 for a functional description of the other items contained within the Model 103 Test Kit.

3-2. BASIC FUNCTIONAL DESCRIPTION

The Simulator simulates the four types of power line disturbances which the Series 606 is designed to measure and record. SLOW AVERAGE, SAG, and SURGE, variations in level at the power line frequency, are generated using an autotransformer technique. IMPULSES are generated by a capacitor discharge which is added to the power line voltage waveform using a step-up transformer.

3-3. DETAILED FUNCTIONAL DESCRIPTION

The Simulator output signal is derived from the power line by using T102 in an autotransformer configuration. The 40 VRMS secondary windings are connected in series. Potentiometer R4 is connected across both outputs. The output voltage of the Simulator is supplied through R103 from the center tap of the T102 secondaries. The secondaries are returned to the 115 VRMS primary through the wiper of R4. In this configuration, when R4 is set to its midpoint, the output voltage from the center tap is equal to the input voltage. By moving R4 clockwise to its stop, one-half of the total secondary voltage may be added to the input voltage, producing a higher output level. Moving R4 to its counter-clockwise stop causes one-half of the total secondary voltage to be subtracted from the input voltage, producing a lower output level.

For generation of line frequency surges (short term voltage increases), S2 is depressed, discharging capacitor C102 through the coil of relay K101. The charge stored in C102 is sufficient to hold K101 closed for approximately 250 ms or until S2 is released. When K101 is closed, it connects the output at point B to a higher voltage point on the T102 secondaries through R102. This causes a higher output level during the time that K101 remains closed. The amount of the increase is determined by the setting of potentiometer R2.

For generation of line frequency sags (short term voltage decreases), S3 is depressed, discharging capacitor C103 through the coil of relay K102. The charge stored in C103 is sufficient to hold K102 closed for approximately 250 ms or until S3 is released. When K102 is closed, it connects the output at point B to a lower voltage point on the T102 secondaries through R104. This causes a lower output level during the time that K102 remains closed. The amount of the decrease is determined by the setting of potentiometer R3.

Impulses are generated by depressing S1. This causes capacitor C105 to trigger SCR Q101. When triggered, the SCR discharges capacitor C107 through the primary of transformer T101. The resulting impulse is increased in voltage by T101 and is added in series with the normal line frequency output. Impulse amplitude is determined by the initial voltage on C107 which is determined by the setting of potentiometer R1 as well as variable resistors R110 and R122.

Two switching functions are provided for convenience of use. NORM/IMP CAL switch S4 allows generation of impulses without the power line frequency output. This allows scope triggering for impulse amplitude observation. PHASE selector switch S6 connects the active output of the Simulator to either Phase A, B, or C. A dummy 115 VRMS nominal output is connected to the other two output phases. This serves two functions. First, a signal is always applied to input Phase A of the Series 606 as required for proper timing (the Series 606 is synchronized to the frequency of the Phase A input signal). Secondly, disturbance printing by the Series 606 is minimized when switching the active signal between phases.

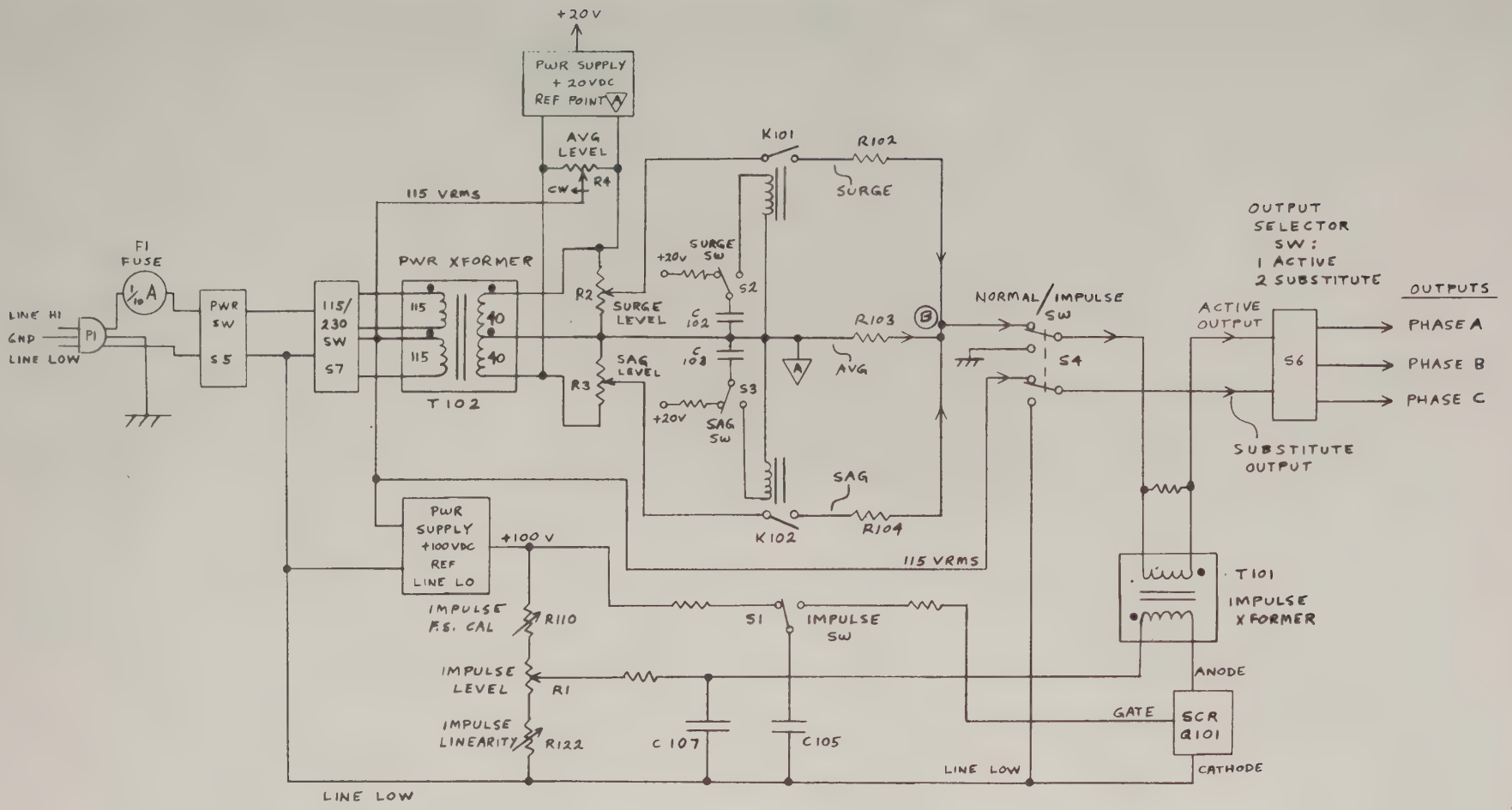


Figure 3-1. Model 604A Disturbance Simulator, Functional Block Diagram

SECTION IV

MAINTENANCE

4-1. SCOPE

This section contains procedures and data that will help ensure continuity of service of the Simulator. The remaining items of the Model K103 Test Kit are not serviceable in the field. They must be returned to the factory for repair. (See paragraph 4-4.)

4-2. RECOMMENDED MAINTENANCE

No routine maintenance is required for the Simulator. If the calibration is in doubt, the Simulator may be recalibrated using the adjustment procedure presented in paragraph 4-3. If adjustment fails to bring the Simulator within specification or if a severe failure is noted, repair should be performed using the information provided in Section III as well as the drawings in Section VI.

CAUTION

Never attempt to calibrate or repair the Simulator without using a line isolation transformer as shown in figure 4-1. Without the isolation transformer, grounded test equipment such as an oscilloscope could not be used. Even with an isolation transformer, hazardous voltage levels exist at most points in the Simulator circuitry.

4-3. ADJUSTMENT PROCEDURE (See fig. 4-1 for test circuit.)

WARNING

DANGEROUS VOLTAGES EXIST ON ALL CIRCUITS.

4-3.1. Average (AVG) Calibration

a. Remove AVG Knob. Set Nominal Input Switch to 115, PHASE Selector Switch to A, ON/OFF Switch to ON, and NORM/IMP CAL Switch to NORM.

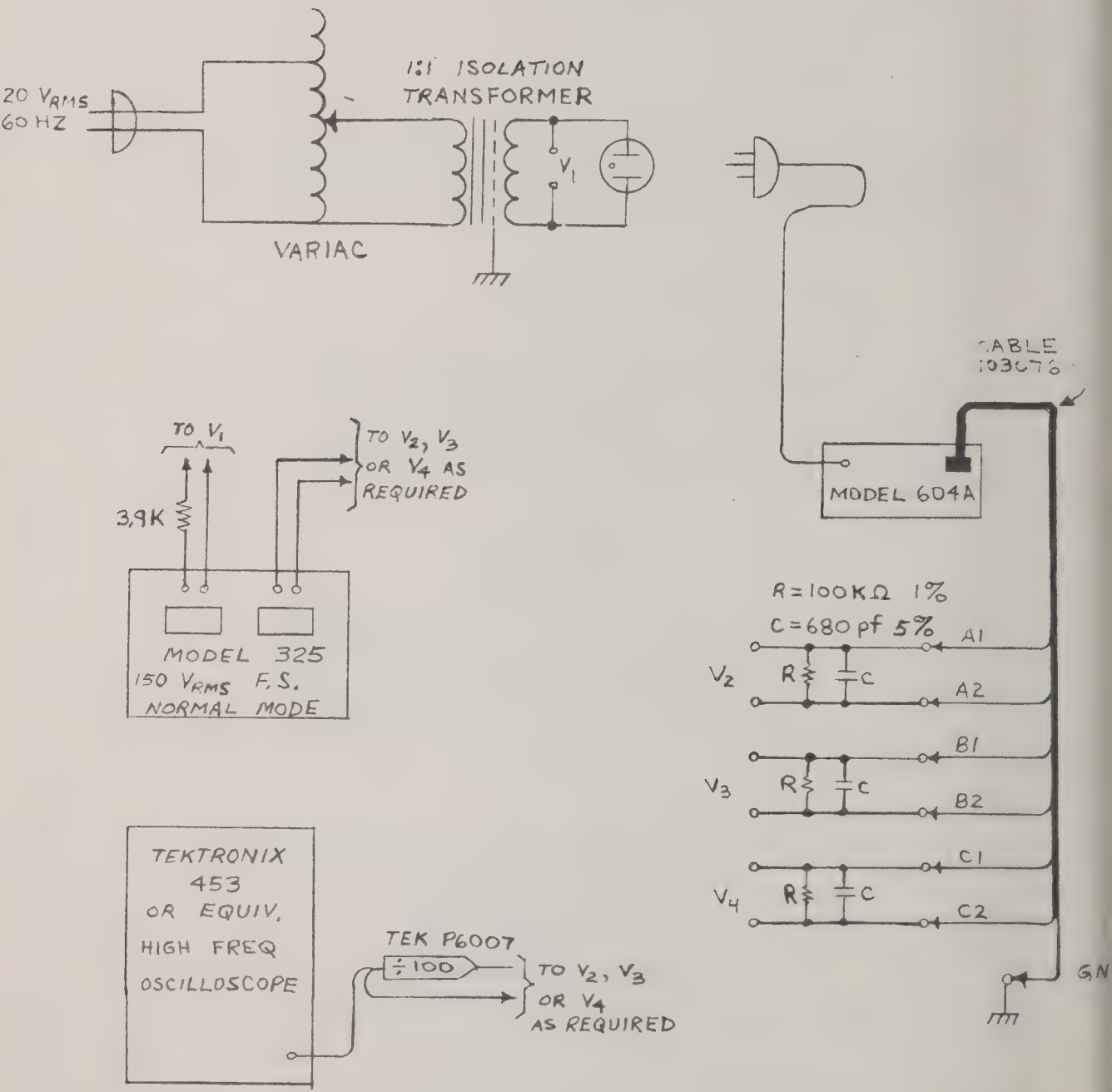


Figure 4-1. Model 604A Test Circuit

b. Adjust variac for $V_1 = 120 \pm 0.5$ VRMS. Adjust R4 for $V_2 = 120 \pm 0.2$ VRMS. Attach AVG knob (with one setscrew) in position indicating 100%. Check V_1 and V_2 for $V_2 = V_1 \pm 0.5$ VRMS with AVG knob set to 100%. If $V_2 = V_1 \pm 0.5$ VRMS, tighten second set screw.

c. With V_1 constant, check V_2 at the indicated settings of AVG knob:

AVG (%)	V_2 (VRMS)
90	106.5 to 109.5
100	119 to 121
110	130.5 to 133.5

Record results on figure 4-2.

d. If any readings are out of specification, correct AVG Knob attachment slightly.

4-3.2. SURGE Calibration

a. Remove SURGE knob. Set Nominal Input Switch to 115, PHASE Selector Switch to A, ON/OFF Switch to ON, and NORM/IMP CAL Switch to NORM.

b. Adjust variac for $V_1 = 120 \pm 1$ VRMS. Adjust AVG Knob for $V_2 = 120 \pm 0.3$ VRMS.

c. Connect TP1 to TP3 and adjust R2 for $V_2 = 132 \pm 0.5$ VRMS. Attach SURGE Knob in position indicating 10%. Check for $V_2 = 132 \pm 0.5$ VRMS. Tighten both set screws.

d. With V_1 constant, check V_2 at the indicated settings of the SURGE knob:

SURGE (%)	V_2 (VRMS)
2	121 to 124
10	131 to 133

Record results on figure 4-2.

e. If any readings are out of specification, correct SURGE knob attachment slightly.

4-3.3 SAG Calibration

a. Remove SAG knob. Set Nominal Input Switch to 115, PHASE Selector Switch to A, ON/OFF Switch to ON, and NORM/IMP CAL Switch to NORM.

b. Adjust variac for $V_1 = 120 \pm 1$ VRMS. Adjust AVG knob for $V_2 = 120 \pm 0.3$ VRMS.

c. Connect TP2 to TP4 and adjust R3 for $V_2 = 108 \pm 0.5$ VRMS. Attach SAG knob in position indicating 10%. Check for $V_2 = 108 \pm 0.5$ VRMS. Tighten both set screws.

d. With V_1 constant, check V_2 at the indicated settings of the SAG knob:

SAG (%)	V_2 (VRMS)
2	116 to 119
10	107 to 109

Record results on figure 4-2.

e. If any readings are out of specification, correct SAG knob attachment slightly.

4-3.4 Impulse (IMP) Calibration

a. Remove IMP knob. Turn R1 fully counter-clockwise and fasten IMP knob so that it points to reference mark.

b. Connect oscilloscope to A2 and GND using ÷100 probe. Probe compensation must have been recently set using oscilloscope square wave calibration signal. Disconnect the digital voltmeter during impulse calibration.

c. Set oscilloscope as follows:

Vertical: 1 V/division

Horizontal: 2 μsec/division

Trigger: INT., D.C., +, TRIG.

d. Set NOMINAL INPUT Switch to 115, PHASE Selector Switch to A, ON/OFF Switch to ON, and NORM/IMP CAL Switch to IMP CAL.

e. Set IMP knob to 500 Volts and depress IMP pushbutton to generate each impulse. Adjust R110 for a 500-volt impulse as measured by the oscilloscope. The impulse should rise (0 to V_{peak}) in approximately 2 μsec.

f. Set IMP knob to 100 Volts and depress IMP pushbutton to generate each impulse. Adjust R122 for a 100 Volt impulse as measured by the oscilloscope.

g. Repeat steps e. and f. until both 100 and 500 volt impulses are correct without further adjustment of R110 or R122.

h. Check impulse level at the indicated settings of the IMP knob:

IMP (V_{peak})	V_2 (V_{peak})
100	90 to 110
300	275 to 325
500	480 to 520

Record results on figure 4-2.

4-4. FACTORY REPAIR

When factory repair is desired, proceed as follows:

1. Contact the Dranetz Engineering Customer Service Department and obtain an Authorization Number.

2. Fill out the Repair/Service Order loosely enclosed in this manual and ship it with the equipment to the Customer Service Department. (A sample of the Equipment Repair Order is permanently bound in this manual. Leave this sample in place for reference.)

AVG

Set (%)	90	100	110
Read (v)	_____	_____	_____
Spec. (v)	106.5/109.5	119/121	130.5/133.5

SURGE

Set (%)		2	10
Read (v)		_____	_____
Spec. (v)		121/124	131/133

SAG

Set (%)		2	10
Read (v)		_____	_____
Spec. (v)		116/119	107/109

IMPULSE

Set (v)	100	300	500
Read (v)	_____	_____	_____
Spec. (v)	90/110	275/325	480/520

Figure 4-2. Model 604A Data Sheet

CUSTOMER SERVICE DEPT.
DRANETZ ENG. LABS., INC.
1000 New Durham Road
Edison, New Jersey 08818

REPAIR/SERVICE ORDER

TEL. (201) 287-3680
(201) 287-2535
TWX: (710) 997-9553
CABLE: DRANETZ

NOTE: THIS COMPLETED FORM MUST ACCOMPANY RETURNED EQUIPMENT

CUSTOMER SHIPPING & BILLING INFORMATION

CUSTOMER P. O. # _____ P. O. DATE _____

SHIP TO: _____ INVOICE TO: _____

In Continental U. S., material will be returned by Dranetz to you by UPS, UPS Blue or other carrier chosen by Dranetz unless otherwise designated.

EQUIPMENT BEING RETURNED

Date of Original Purchase: _____ Original P. O. # _____

Model No. _____ S/N _____

Model No. _____ S/N _____

Ancillary equipment also being returned (If you neglect this, these items may not be returned to you).

☐ Power & Other Cables _____ ☐ Instr. Book _____

☐ Plug-ins (incl. S/N) _____ ☐ Connectors _____

☐ Other _____

RETURN AUTHORIZATION

Have you discussed the problem with Dranetz Sales or Service personnel?

Dranetz Return Authorization # _____

By: _____

If so, with whom _____ Date: _____

Whom should the Dranetz Customer Service Dept. contact for technical questions?

( )

NAME (Print) DEPARTMENT TELEPHONE

DESCRIPTION OF PROBLEM

Please be detailed, explicit and complete. Include test data, if this helps to describe the problem.
IMPORTANT: Repairs cannot be made unless this section is completely filled out.
(Attach added sheets if necessary)

CHECK WHERE APPLICABLE: IS MALFUNCTION RELATED TO: Warmup ☐ Temperature ☐

Intermittency ☐ Mechanical Handling ☐ Visual Defects ☐ Grounding ☐ Test Data Attached ☐

INITIATOR OF THIS ORDER

NAME/TITLE SIGNATURE TELEPHONE

(SEE OTHER SIDE FOR INSTRUCTIONS)

IMPORTANT (ENCLOSE THIS ENTIRE FORM WITH EQUIPMENT)

INSTRUCTIONS FOR REPAIR ORDER – DRANETZ ENGINEERING LABS.

IMPORTANT: FOLLOW INSTRUCTIONS & USE THIS FORM. IT IS DESIGNED TO HELP US HELP YOU.

1. Before returning equipment to our factory, call our Customer Service Department, Tel:(201) 287-2535 Give the model No., serial number, and information on the problem.

   A. Our specialists may be able to solve your problem rapidly without equipment return.

   B. If equipment return is needed, you will be supplied with appropriate instructions and authorization information to expedite service.

2. If return is to be made,

   A. Fill out the other side of this form COMPLETELY.

   B. Enclose original of form INSIDE the shipping carton, preferably attached by masking tape to the equipment.

   C. Ship prepaid (including insurance); we will return prepaid unless otherwise advised by you.

   D. IMPORTANT - PACK PROPERLY! SHIPPING DAMAGE WILL BE CHARGED TO YOU!

NOTE:

Statement of Warranty - All products of Dranetz Eng. Labs., Inc. are warranted to the original purchaser against defective material and workmanship for a period of one year from the date of delivery. Dranetz will repair or replace, at its option, all defective equipment returned, freight prepaid, during the warranty period, without charge for repair, provided there is no evidence that the equipment has been mishandled or abused.

FILL OUT OPPOSITE SIDE OF THIS FORM AND RETURN WITH EQUIPMENT.

INSTRUCTIONS FOR REPAIR ORDER – DRANETZ ENGINEERING LABS.

SECTION V

PARTS LIST

5-1. SCOPE

This section lists the parts required to support the Disturbance Simulator. Sufficient information is included to permit maintenance personnel to identify each maintenance part by part number, description, and supply source. Table 5-1 lists and identifies the manufacturers referenced in the parts list.

Table 5-1. List of Manufacturers

NOTE: When no manufacturer is specified in the parts list, the referenced part number is on the MIL Spec List. MIL spec parts are manufactured to meet Military Specifications and are readily available from a variety of suppliers.

1. Alco Electronic Products, Inc., 1551 Osgood Street, North Andover, Massachusetts 01845
2. Bourns, Inc., Trimpot Products Division, 1200 Columbia Avenue, Riverside, California 92507
3. Bussmann Manufacturing Division, McGraw Edison Company, 2536 West University Street, St. Louis, Missouri 63107
4. C & K Components, Inc., 103 Morse Street, Watertown, Massachusetts 02172
5. Cambion, Cambridge, Massachusetts
6. Cinch-Jones Connector Division of TRW, 1500 Morse Avenue, Elk Grove Village, Illinois 60007
7. Clarostat Manufacturing Company, Inc., Washington Street, Dover, New Hampshire 03820
8. Cornell-Dubilier Electric, 150 Avenue L., Newark, New Jersey 07101
9. Cutler Hammer, 4201 North 27th Street, Milwaukee, Wisconsin 53216
10. Dranetz Engineering Labs Inc., 1000 New Durham Road, Edison, N.J. 08818
11. Electrocube, Inc., 1710 S. Del Mar Avenue, San Gabriel, California 91776.
12. Elmenco-Arco Electronics, Community Drive, Great Neck, New York 11022

13. F-Dyne Electronics Co., 449 Howard Avenue, Bridgeport, Connecticut 06605
14. Signal Transformer Company, 1 Junius Street, Brooklyn, New York 11212
15. Sprague Electric Company, 645 Marshall Street, North Adams, Massachusetts 01247
16. Struthers-Dunn, Inc., Lambs Road, Pitman, New Jersey 08071

REPLACEABLE PARTS LIST

MODEL 604A DISTURBANCE SIMULATOR

Reference Designation	Manufacturer	Part Number	Description
	DEL	103076	Cable Assembly
P1	Cinch-Jones	P-308-CCT-L	Plug (8 pins)
J1	Cinch-Jones	S-308-AB	Receptacle (8 socket)
R1	Clarostat	RV4SAYSD104A	Var. Res. 100K
R2, R3	Clarostat	RV4SAYSD102A	Var. Res. 1K
R4	Clarostat	RV4SAYSD502A	Var. Res. 5K
S1, S2, S3	Cutler-Hammer	SAZZGDX13-3	Switch, Pushbutton (DPDT)
S4, S5	C & K	7201	Switch, Toggle (DPDT)
S6	Alco	MSS-4300	Switch, Slide (4P3T)
S7	Switchcraft	46206LFR	Switch, Slide (115/230)
F101	Bussman	MDL-100	Fuse, 1/10 Amp. Slow Blow
R101		RN60C1742F	Res. 17.4K ± 1%, 1/8W
R102, R104		RN60C2431F	Res. 243K ± 1%, 1/8W
R103		RN60C3321F	Res. 3.32K ± 1%, 1/8W
R105, R106, R118, R115		RCR07G102J	Res. 1K ± 5%, 1/4W
R107, R108		RCR07G431J	Res. 430Ω ± 5%, 1/4W
R109		RCR07G332J	Res. 3.3K ± 5%, 1/4W

REPLACEABLE PARTS LIST (Cont'd.)

Reference Designation	Manufacturer	Part Number	Description
R110	Bourns	3386W-1-104	Var. Res. 100K
R111		RCR07G56ZJ	Res. 5.6K ± 5%, 1/4W
R113		RCR07G241J	Res. 240Ω ± 5%, 1/4W
R114		RCR07G43ZJ	Res. 4.3K ± 5%, 1/4W
R116		RCR07G112J	Res. 1.1K ± 5%, 1/4W
R117		RCR07G123J	Res. 12K ± 5%, 1/4W
R120, R121		RCR07G471J	Res. 470Ω ± 5%, 1/4W
R122	Bourns	3386W-1-203	Var. Res. 20K
C101, C102, C103		CS13F476K	Capacitor 47μf ± 10%, 35V
C104, C106		CK63AW103M	Capacitor, .01μf ± 20%, 500V
C105	Sprague	192P10392	Cap. .01μf ± 10%, 200V
C107	Electrocube or F-Dyne	625D1B155K or MPC-12-1.5-100-10	Cap. 1.5μf ± 10%, 100V
C108	Elmenco	DM19-332J	Cap. 3300pf ± 5%, 500V
C109	Cornell Dubilier	WBR10-150	Cap. 10μf ± 10%, 150V
T101	DEL	103077	Transformer
T102	Signal	DPC-40-110	Transformer
CR101, CR102		1N4009	Diode
CR103, CR104, CR106, CR107		1N4005	Diode
CR105		1N968B	Zener Diode
CR108, CR109		1N978B	Zener Diode
Q101		2N4442	SCR
K101, K102	Struthers Dunn	MRRNIA-24V	Relay, 24 Volts

SECTION VI

DIAGRAMS

Figure

6-1 Model 604A Disturbance Simulator, Schematic Diagram . . . 6-2

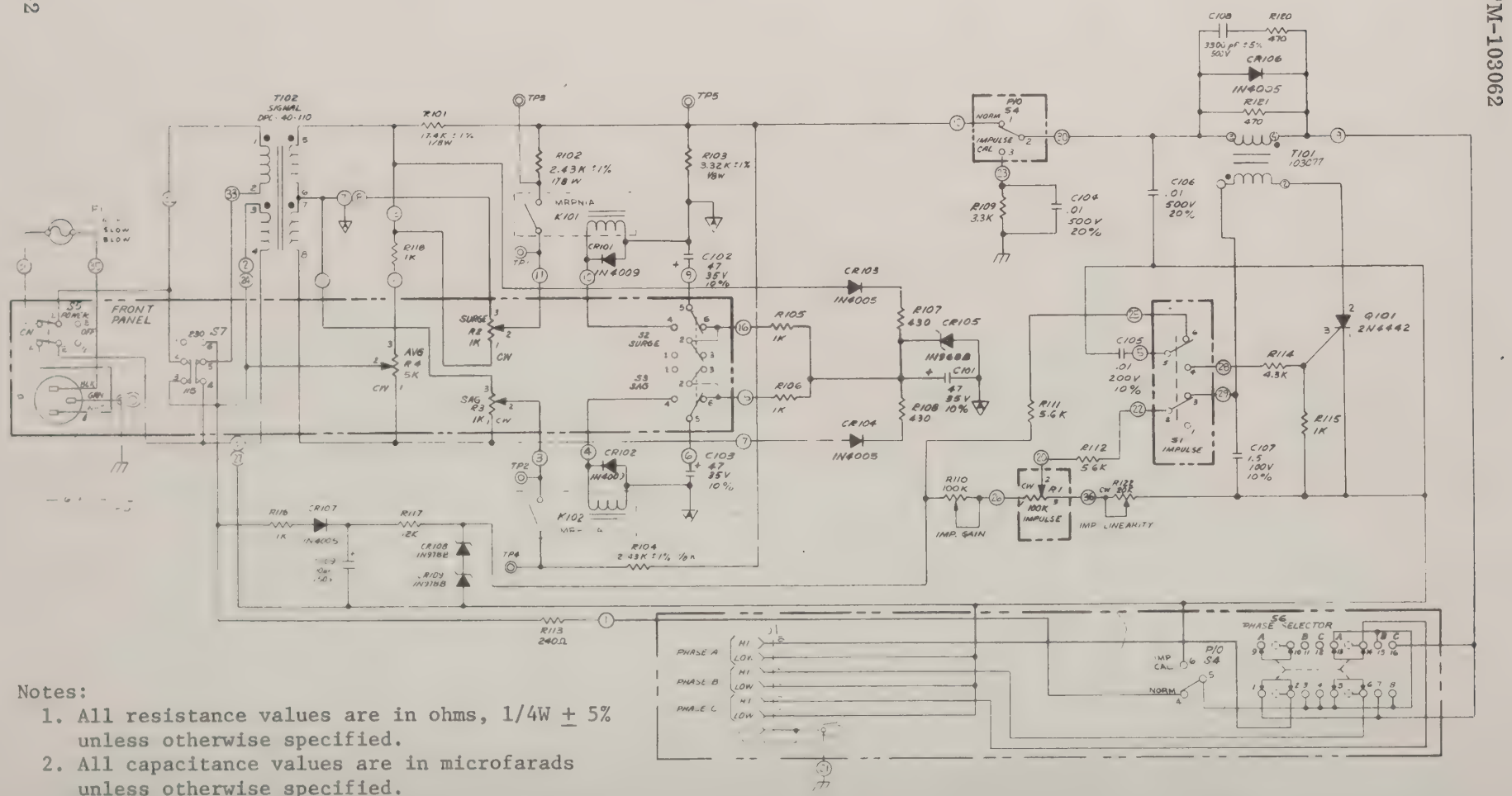
6-2 Model 604A, Interconnection Diagram 6-3

6-3 Model 604A, Assembly Diagram 6-4

6-4 Model 604A, Parts Location 6-5

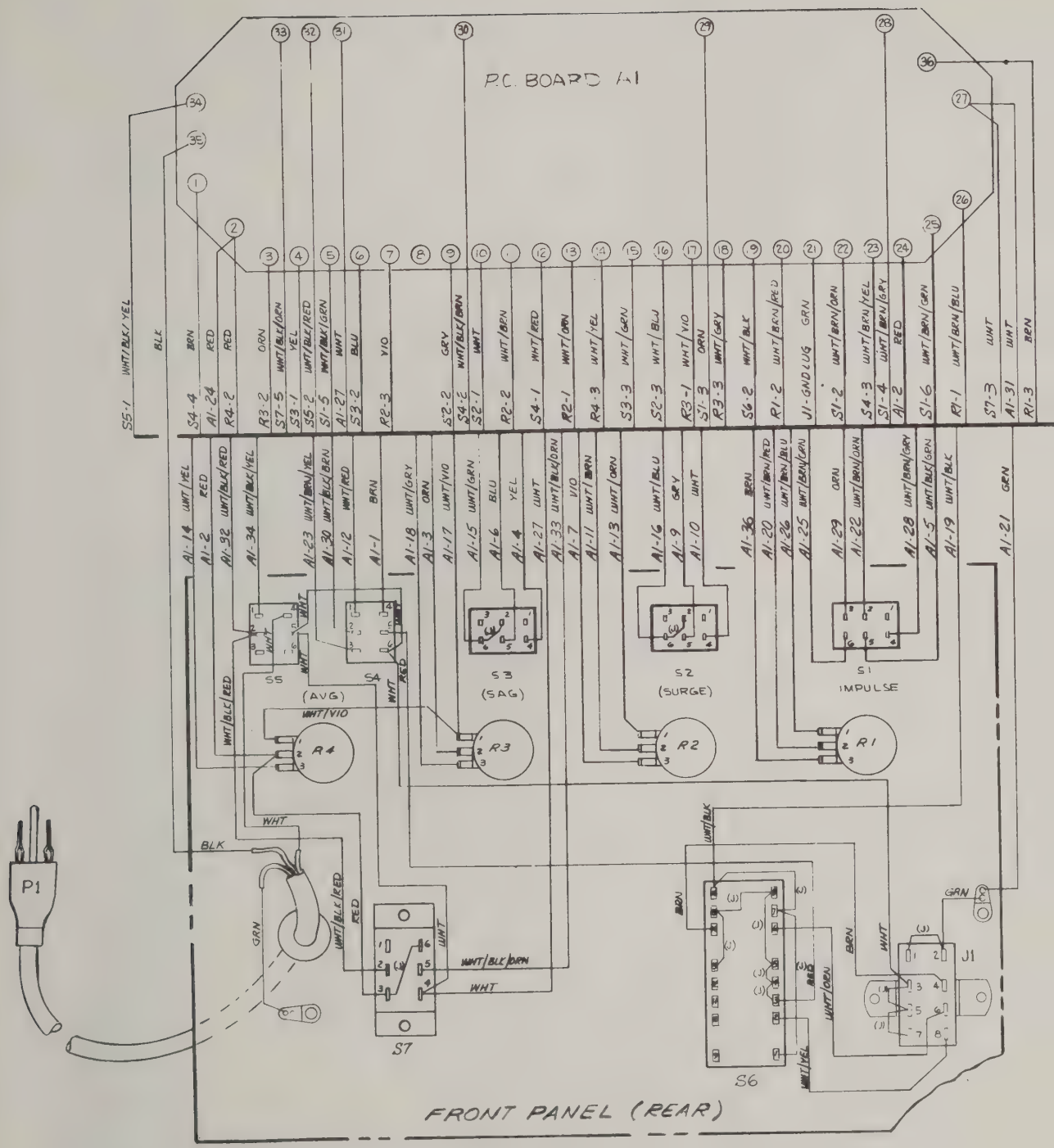
REVISION INFORMATION

B S6 was Switchcraft 49331LS, C108 was .0033 ± 10%, 600V. R110 was 20K, R113 was 3.3K. Added R122, Removed R119. Revised C105, S7, S2, and S3 wiring. TP5 was TP3. Added TP3 and TP4.



Notes:

1. All resistance values are in ohms, 1/4W ± 5% unless otherwise specified.
2. All capacitance values are in microfarads unless otherwise specified.
3. Components located within dark phantom lines appear on front panel.



NOTE: All wires to be 24 AWG unless otherwise specified.

REVISION	INFORMATION
B	Revised S2, S3, S6, S7, and R1 wiring. Added A1-36. Added wire colors.

Figure 6-2. Model 604A Disturbance Simulator, Interconnection Diagram

REVISION INFORMATION

B Heyco bushing SR6P3-4 was Heyco 5P4 or H.H. Smith 939. S6 was Switchcraft 49331LS. Repositioned front panel ground lug away from corner. Specified small pattern flat washer on printed circuit board mating screws. Changed bottom 4 slots on J1 from Vertical to Horizontal.

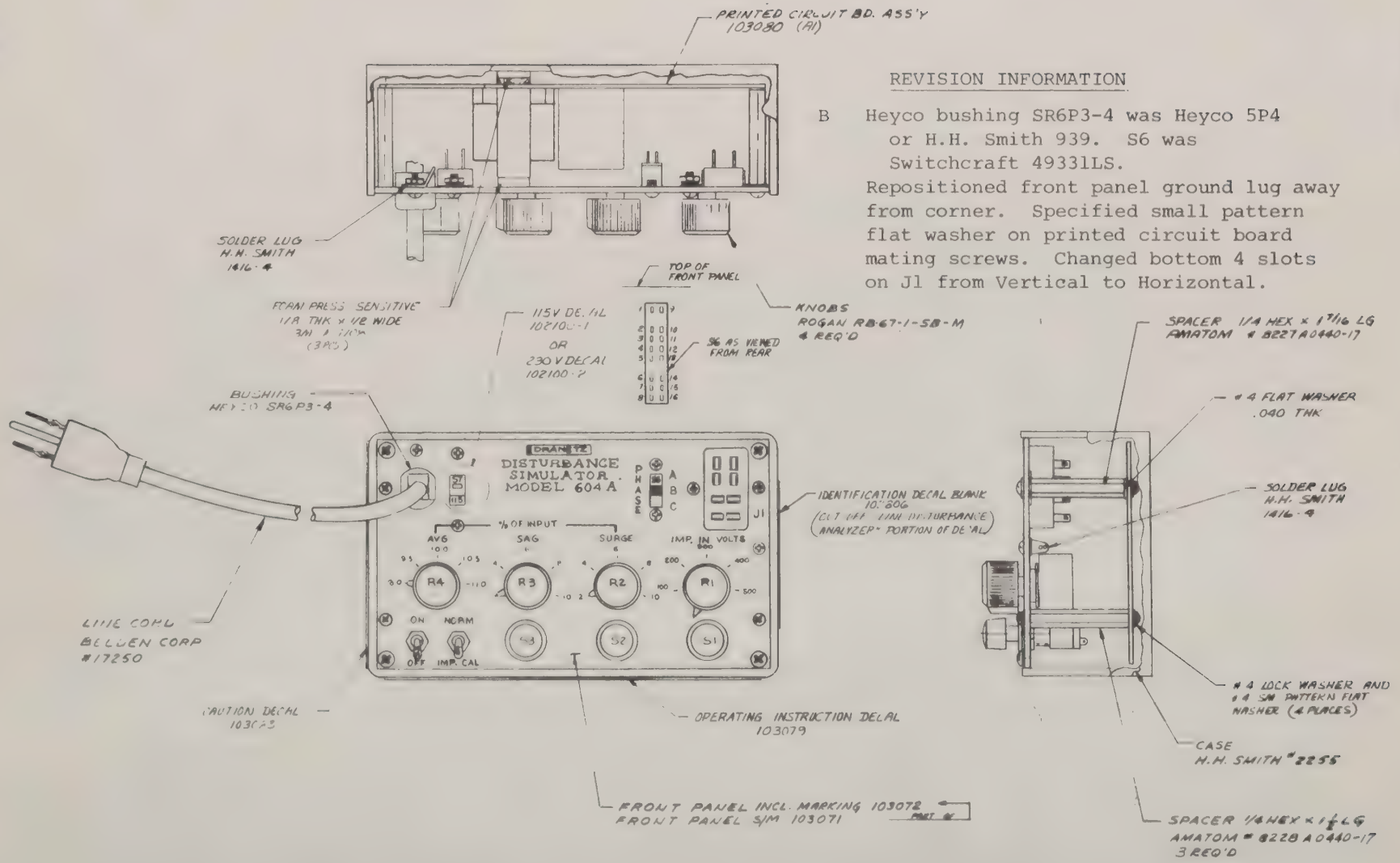
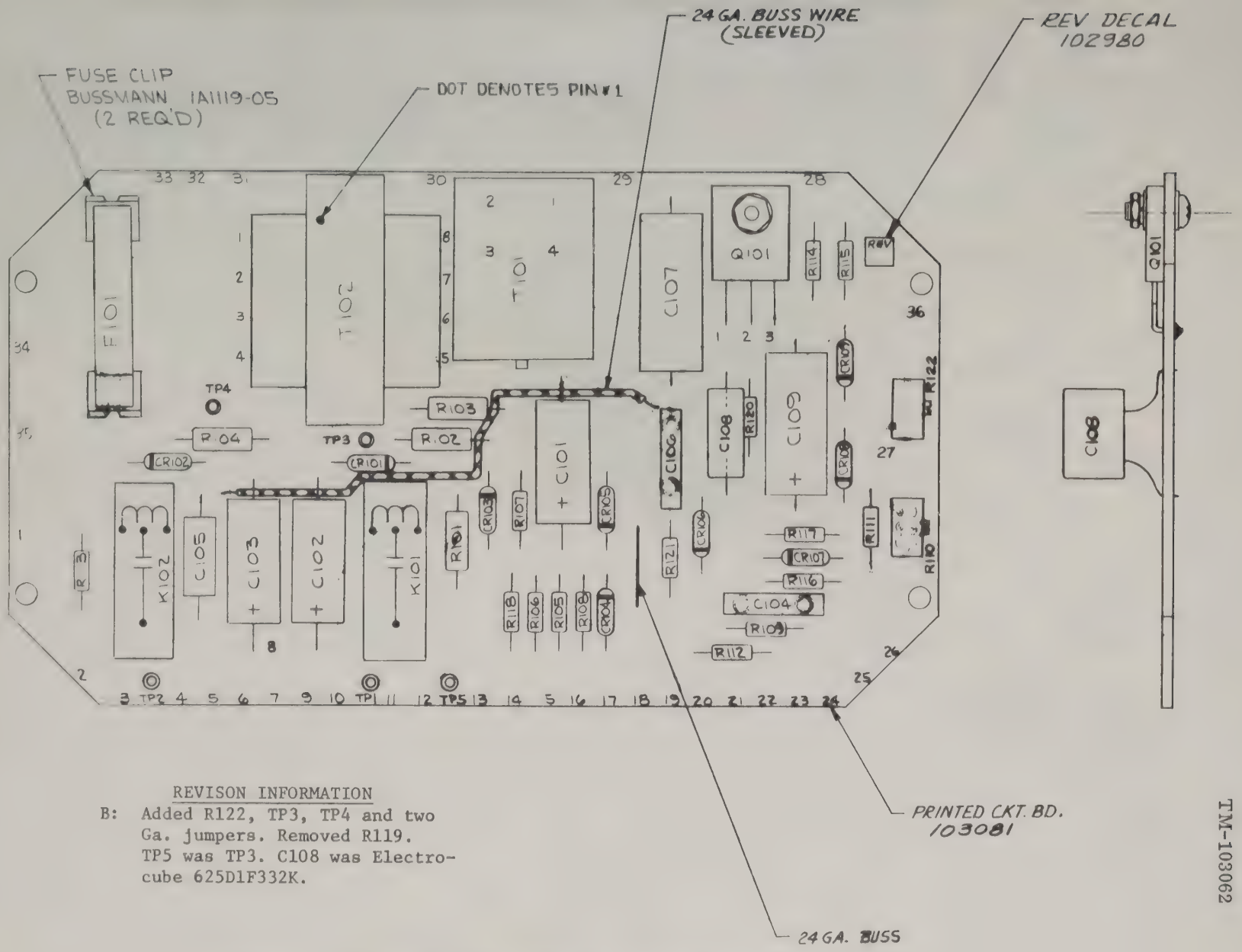

PRINTED CIRCUIT BD. ASS'Y 103080 (A1)
SOLDER LUG H.H. SMITH 1616-4
FOAM PRESS SENSITIVE 1/8 THK x 1/2 WIDE
TOP OF FRONT PANEL
KNOBS ROGAN RB-67-1-SB-M 4 REQ'D
115V DECAL 102103-1 OR 230V DECAL 102100-2
96 AS VIEWED FROM REAR
SPACER 1/4 HEX x 1 7/16 LG AMATOM # 8227A0440-17
#4 FLAT WASHER .040 THK
BUSHING HEYCO SR6P3-4
DRANETZ
DISTURBANCE SIMULATOR MODEL 604A
PHASE A B C
J1
IDENTIFICATION DECAL BLANK 103076
(CUT OFF "LINE DISTURBANCE ANALYZER" PORTION OF DECAL)
SOLDER LUG H.H. SMITH 1416-4
% OF INPUT
AVG SAG SURGE IMP. IN VOLTS
R4 R3 R2 R1
ON NORM
OFF IMP. CAL
S3 S2 S1
LINE CORD BELDEN CORP #17250
CAUTION DECAL 103083
OPERATING INSTRUCTION DECAL 103079
#4 LOCK WASHER AND #4 SM PATTERN FLAT WASHER (4 PLACES)
CASE H.H. SMITH #2255
FRONT PANEL INCL. MARKING 103072
FRONT PANEL S/M 103071
SPACER 1/4 HEX x 1 1/4 LG AMATOM # 8228A0440-17 3 REQ'D

Figure 6-3. Model 604A Disturbance Simulator, Assembly Diagram



REVISON INFORMATION

B: Added R122, TP3, TP4 and two Ga. jumpers. Removed R119. TP5 was TP3. C108 was Electro-cube 625D1F332K.

6-5/6-6

TM-103062

Figure 6-4. Model 604A Disturbance Simulator Parts Location

DRANETZ

PRODUCT CATALOG

PRECISION INSTRUMENTATION FOR

- Phase/Gain
- Impedance
- Current
- Voltage
- Quality Factor Q
- Time/Frequency
- Power Line Disturbance
- Sequence of Events
- Harmonic Power

DRANETZ

Worldwide Leadership In Precision
Impedance/Phase/Power Instrumentation

INTRODUCTION

DRANETZ ENGINEERING Laboratories, Inc. is a leader in the design and manufacture of precision AC test instruments and systems. This equipment is widely used for measurement of impedance, admittance, transfer function, voltage, current and phase.

THIS CATALOG contains complete descriptions and specifications on many Dranetz instruments. With current price lists, this information is sufficient for specifying and ordering equipment. Additional information is often available, including application notes as well as Bulletins describing specific instruments and systems. These can be obtained by contacting our main plant or your local field representative.

DRANETZ EQUIPMENT utilizes the latest developments in the electronics state-of-the-art to provide the most advanced equipment with high quality at an economical price. Each instrument utilizes the latest in solid state and microcircuit components and, where possible, uses modular design. Flexibility and versatility are designed into these instruments at their concept. Computer compatibility is often available in standard instruments, and options can be provided for special requirements. In addition, the plug-in concept of these instruments assures exceptional flexibility.

OUR HIGHLY TRAINED FIELD AND PLANT ENGINEERS are readily available to assist you or supply you with additional information to enable you to meet your specific requirements. A telephone call will bring this service to you immediately without cost or obligation.

AFTER SALE SERVICE is an important reason for purchasing Dranetz equipment. Each instrument is warranteed for 1 full year after purchase. Dranetz maintains technical field representatives throughout the U.S. and in other countries, fully backed by in-plant experts. Wherever possible, application and service problems are solved on site. In addition, the company provides prompt and immediate service for equipment returned from the field. Frequently loan equipment is available for use during equipment repair.

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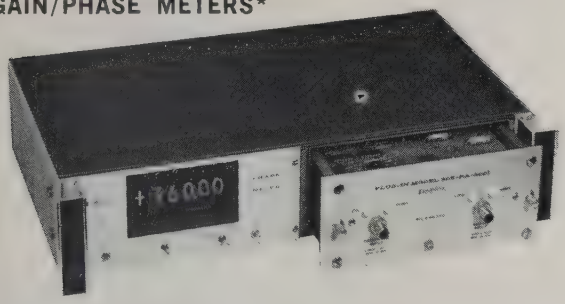
For information on products assigned Federal Stock Numbers (FSN) or available on Federal Supply Schedules (GSA) please contact factory.

DRANETZ

SERIES 305

SUPER PERFORMANCE PHASEMETERS AND GAIN/PHASE METERS*



305 Series Phasemeters provide the highest available accuracy, along with many operational features. Designed for the calibration laboratory, the design engineer's bench, the production line and automatic test systems, the 305 is the most widely accepted phasemeter in industrial, and governmental organizations. **

FEATURES

- No hands 86 dB dynamic range
- Automatic or programmable operation and calibration
- Highest accuracy — to 0.03°
- Repeatability better than 0.01°
- Rejects harmonics and noise
- Wide frequency range — 1 Hz to 11 MHz
- IEEE 488 Bus Compatibility

FLEXIBILITY THROUGH PLUG-IN CONCEPT

The plug-in concept of the 305 offers a wide selection of characteristics. Three standard mainframes and nine plug-ins are complemented by a variety of options, such as programmability, high speed and autocalibration. Special modifications are also available. In addition, modular construction throughout provides maintainability at both component and P.C. card levels for ease and speed of servicing.

WIDE FREQUENCY RANGE

The basic mainframe provides a direct frequency coverage of 2 Hz to 700 kHz with high accuracy. By the use of frequency converting plug-ins such as the 305-PA-3005, standard units can handle frequencies up to 11 MHz. Special units can be provided for higher frequency.

NO HANDS OPERATION

The Series 305 Phasemeters require no controls or adjustments by the operator. These units are also equipped with several significant automatic features. These include automatic selection of angle range, automatic sensing of leading or lagging angle, automatic selection of the output time constants, and automatic setting of AC gains.

HIGHEST ACCURACY

Accuracy to better than ±0.03° is attained with precision mainframes and carefully designed plug-ins. Mainframes exhibit precise zero crossing detection, angle-to-DC conversion linearity to approximately ±0.01° and outstanding DC stability. Plug-ins are designed for accurate conversion of sine wave (also square wave) inputs to square waves through carefully controlled amplifier circuitry, use of gain autoranging, and harmonic filters where necessary.

INSENSITIVITY TO INPUT LEVEL

Series 305 plug-ins are available with a guaranteed accuracy of better than ±0.05° even with independent input level variations of 60 dB. Typical accuracy can approach ±0.03° as shown on the following page.

NON-AMBIGUOUS ANGLE READINGS

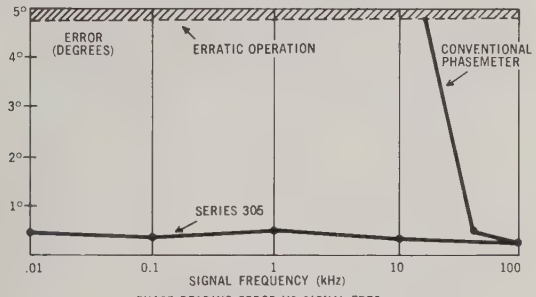
Two phase angle ranges in the 305 eliminate the ambiguity or "dead zone" error inherent in all other phasemeters (usually at 0°/360° or −180°/+180°). An automatic system switches to the 0°/360° range for angles near 180° and to the −180°/+180° range for angles near 0°. Unique guard bands prevent dead zones near switching points.

REPEATABILITY, STABILITY, AUTOCALIBRATE

Repeatability of the 305 is better than ±0.005°; temperature coefficient is ±0.001°/°C; and DC output drift is better than ±0.05° over any 30 day period. The autocalibrate feature eliminates virtually all DC errors in digital panel readout and BCD rear panel outputs.

NOISE IMMUNITY

Unique patented circuitry minimizes noise errors and makes possible accurate phase measurements under noise levels where other phasemeters become completely useless. The accompanying curve compares the phase error of the model 305 with that of a conventional phasemeter with broad band noise in both channels.



PHASE READING ERROR VS SIGNAL FREQ. FOR GAUSSIAN NOISE (FLAT TO 5 MHz) IN BOTH CHANNELS FOR S/N = 10

PROGRAMMABLE OPERATION

Standard mainframes are provided with rear connections for overriding the automatic time constant and angle range selectors by relay contact closures. Options are available for full compatibility with IEEE 488 Interface Bus and for control by DTL and TTL logic.

DIGITAL READOUT

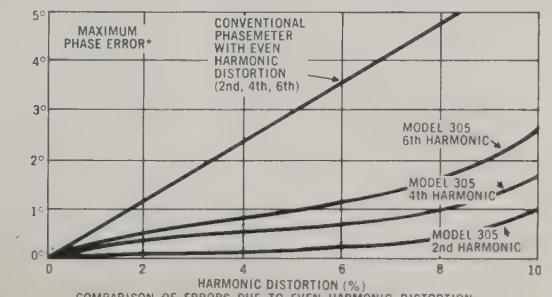
In addition to analog DC output, standard mainframes are available with up to 5 digit panel readouts (i.e., 0.00° to ±180.00° and 0.00° to +360.00°) and BCD outputs for each digit. Autocalibrate feature eliminates virtually all meter drift and scaling errors.

RAPID PHASE NULLING

For production testing of filters and other networks, an additional analog deviation-panel meter (305D) provides an easy means of adjusting a test angle to any accurate value. Presetting can be done in seconds without any other equipment. The precision digital panel meter monitors actual test angle continuously.

ABILITY TO REDUCE HARMONICS

The 305 is designed to reduce significantly the errors due to even harmonic distortion without the use of filters. The accompanying curve compares the error due to even harmonic distortion (maximized for worst case harmonic angle) on conventional phasemeters and on the model 305. (Odd harmonics in-phase with fundamental contribute no error.)



COMPARISON OF ERRORS DUE TO EVEN HARMONIC DISTORTION
(* For worst case phase relationship between harmonic and fundamental)

*Manufactured under U.S. Pat. No. 3,725,781
**For extensive application information, write for availability of "Applications Handbook of Precision Phase Measurement."

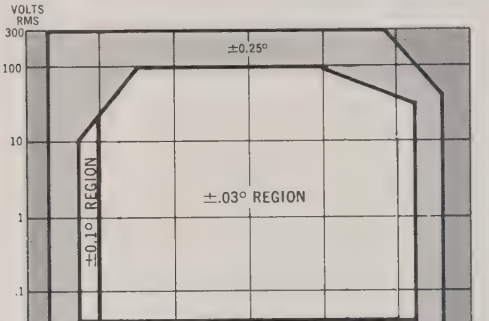
SERIES 305

SUPER PERFORMANCE PLUG-INS

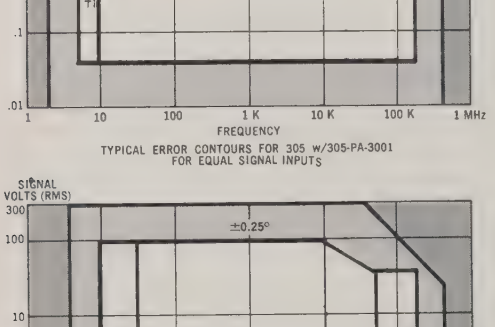
The variety of plug-ins available provides unlimited flexibility for the Series 305 Phasemeters in meeting many phase measurement problems. In addition to an expanding line of standard plug-ins, custom units can be designed for special needs.

305-PA-3001 AUTORANGING PLUG-IN

This plug-in features high accuracy over a broad range of input levels and frequencies. Autoranging of gain in each channel assures high accuracy (±0.05° guaranteed) over a dynamic range of 60 dB (50 mV to 50 V rms) for independent levels of inputs, with a useful range of 90 dB (10 mV to 300 V rms). This plug-in covers the range from 2 Hz to 700 kHz, with its highest accuracy in the 50 Hz to 50 kHz range. The curves shown illustrate typical accuracies as a function of level and frequency. The 305-PA-3001 also features compatibility with Tektronix probes and includes front panel lamps to indicate when either input signal is below 50 mV or above 50 V rms.



TYPICAL ERROR CONTOURS FOR 305 w/305-PA-3001 FOR EQUAL SIGNAL INPUTS



TYPICAL ERROR CONTOURS FOR 305 w/305-PA-3001 FOR UNEQUAL INPUTS — REF. 0.3 VOLTS RMS

While the above accuracies apply to sine wave inputs, this instrument can also be used for square wave and amplitude modulated signals.

305-PA-3002 SINGLE RANGE PLUG-IN

The 305-PA-3002 is similar to the model 305-PA-3001 except that it does not include autoranging or limit indicator lamps. For sine wave inputs the standard unit is designed for guaranteed ±0.05° accuracy (typically ±0.03°) over independent signal levels of 50 mV to 500 mV rms, with a slight reduction in accuracy from 10 mV to 3 V rms. Other level ranges can be supplied on special order; Tektronix probes can be used for high input levels. This plug-in is useful for sine wave, square wave and amplitude modulated signals.

305-PA-3005 HIGH FREQUENCY PLUG-IN

This high frequency plug-in is designed for high accuracy to 11 MHz. Using a self tracking oscillator, the input signals are converted to 40 kHz for precision measurement by the mainframe. Input attenuators (50 ohms) are provided with 10 dB steps, to cover a range of 1 mV to 3 V rms in either channel. Front panel lamps indicate when input levels are out of range or when level controls are improperly set. The self tracking oscillator can be controlled by channel A signal or by a third independent signal.

305-PA-3007 PROGRAMMABLE AND AUTORANGING PLUG-IN

This programmable plug-in features all of the characteristics of the model 305-PA-3001. In addition it includes increased input gain to achieve operation down to 1 mV rms. The unit can be operated either in an automatic or programmable mode. Without rear connections, the plug-in operates automatically as a 305-PA-3001; however, by utilizing rear connectors, the internal autoranging can be overridden and additional internal gain can also be inserted. Programming is available by DTL and TTL logic.

305-PA-3008 SINGLE FREQUENCY PLUG-IN

The 305-PA-3008 is a special purpose plug-in designed for precision calibration of 50 Hz, 60 Hz and 400 Hz power line equipment such as wattmeters, phase detectors and watt hour meters. This instrument can measure phase difference between two voltages, two currents or between a voltage and a current. The unit covers a voltage range of 25 V to 250 V rms and a current range of 0.1 to 5 A rms. The basic plug-in covers the frequency range of 50 Hz to 500 Hz. Plug-in filters, available for 50 Hz, 60 Hz and 400 Hz, assure reduction of second harmonic by at least 40 dB and higher harmonics by at least 50 dB. A front panel zero control provides adjustment for high accuracy (±0.1°) at any single frequency.

305-PA-3009 WIDE BAND NETWORK ANALYZER PLUG-IN (GAIN/PHASE/AMPLITUDE)

This plug-in measures the voltage amplitude of each signal input (in volts or dBV, selectable by operator), the phase difference between inputs, and the amplitude ratio of inputs. Featuring autoranging of gain in both channels, it requires no manual setting of gains for any measurement. Simultaneous DC outputs on mainframe are proportional to all four fuctions. A front panel switch selects the measuring mode for digital panel readout — channel A voltage, channel B voltage, phase difference, or amplitude ratio. Lamps on the front panel of the plug-in indicate the proper decade multiplier. The 305-PA-3009A is designed for extending the low frequency range.

305-PA-3010 SPECIAL PURPOSE PLUG-IN

This plug-in is typical of special purpose plug-ins which can be supplied to meet unique problems. Having high input impedance, it is equipped with closely matched low pass filters to pass 125 Hz signals while rejecting 400 Hz signals, solving problems in many types of servo control systems. Similar units can be readily designed for other special voltage and frequency applications.

305-PA-3015 PROGRAMMABLE PLUG-IN

Intended for use in automatic test systems, this plug-in has two selectable filters for harmonic rejection and selectable gains to handle inputs from 50 mV to 50 V rms. Filter (or filter out) selection as well as gain switching is accomplished by contact closures across terminals on the rear of the main frame.

PRECISION TRANSFORMER ISOLATION NETWORKS

Dranetz TR 3100 series networks are available for input voltage isolation with minimum phase error and flat gain response. For use with balanced or signal ended sources, these units are equipped with internal preamplifiers to produce outputs in the 30 mV to 3 V rms range (for use with 305 Series Phasemeters) for input levels from 50 mV to 500 V rms. These transformer units are packaged for direct plug-in into the input BNC's of the phasemeter, and draw B+ power from the front panel accessory connector of the phasemeter plug-in. Size 2¾" x 2¾" x 2". Input: banana jack. Output: BNC.

Model TR—	Zin	Com. Mode Rej: >60 dB for frequency	Range for ±0.1° typical shift	Range for ±0.3° typical shift	Gai ±2
3101	1 megΩ 70 pF	Below 1 kHz	20-400 V rms 50 Hz-20 kHz	5-400 V rms 10 Hz-25 kHz	x 0.0
3102	100 kΩ 70 pF	Below 10 kHz	2-40 V rms 50 Hz-20 kHz	0.5-40 V rms 10 Hz-25 kHz	x 0.1
3103	10 kΩ 70 pF	Below 25 kHz	0.2-4 V rms 50 Hz-20 kHz	0.05-4 V rms 10 Hz-25 kHz	x 1.0

SERIES 305

SUPER PERFORMANCE PHASEMETERS

MAINFRAME SPECIFICATIONS

Frequency Range: 2 Hz to 11 MHz (see plug-in data)

Angle Ranges: 0.00° to ±180.00° or 0.00° to +360.00° manually or automatically selected. End-of-range measurement errors are prevented by 15° automatic guard zones.

Analog Output

Range: −1.8000 to +3.6000 Vdc corresponding to measured angle; 10.0 mVdc per degree

Accuracy: See plug-in specifications

Output Impedance: 100 ohms

DC Resolution: Infinite

Linearity: Approx. ±0.01°

Repeatability: Better than ±0.005°

Time Constants: Automatically selected; 10 ms for frequency >5 kHz, 50 ms >500 Hz, 350 ms >50 Hz, 700 ms >2 Hz (Note: 4.6 time constants to respond to better than 99% of step change).

Warm-up Drift: Approx. 0.05° after first minute.

Long Term Drift: Typically less than ±0.05° per month

Temp. Coefficient: Approx. ±0.001°/°C

Recommended Output Devices: Recorders, DVM's, A-D Converters, Printers

Self Check: Front panel switches; dc outputs correspond to −180.00°, 0.00°, +180.00° and +360.00°

Error Rejection: False triggers due to high frequency noise are locked out for signal to noise ratios better than 10:1. Errors and fluctuations due to waveform dissymmetry or low frequency noise reduced by at least 10 to 1.

Harmonic Rejection: Worst case errors due to even harmonic distortion reduced by approximately 5:1 without filters. Odd harmonics in-phase with fundamental contribute no error.

Operator Adjustments: None.

Operating Temp. Range: 0° to +50°C

Grounding: Independent grounds for signal, chassis, and power line. (For safety, chassis and power line grounds connected at factory.)

Remote Programmability (standard on all mainframes): By rear connector pins. Override by contact closure of automatic time constant selection and angle range. Factory installed wiring from rear connector to plug-in for use with programmable plug-ins.

Modular Construction: Circuits on removable plug-in cards, extenders supplied for ease in servicing.

Size: 3½" high, 16" deep, 19" rack/portable package; shipping 22½" x 22½" x 6½".

Weight: 20 lbs. (9 kg.); shipping 30 lbs. (14 kg.).

Power: 115/230 V, 50-400 Hz, <0.75 A (specify voltage and frequency when ordering).

Plug-In Accommodation: Accepts 305-PA-( ) plug-ins. Mainframes and plug-ins are interchangeable.

ANGLE PRESENTATION

	Model 305	Model 305B	Model 305C	Model 305D
DIGITAL				
Display	None	4 digit plus sign	5 digit plus sign	
Angle Ranges	Not Applicable	0.0° to ±180.0° and 0.0° to +360.0°	0.00° to ±180.00° and 0.00° to +360.00°	
Resolution	NA	0.1°	0.01°	
BCD Output	None	BCD coded (1248), 4 lines per digit plus polarity line; TTL/DTL compatible (<0.8 V to > +2.4 V dc). Read and hold on command, and data ready features available on rear connector.		
Warm-up Time	NA	30 minutes (1 minute with option 107)		
Zero & FS Controls	NA	Front panel for FS & 0 (no adjustments with option 107)		
ANALOG				
DC Output	10.0 mV/°; 0.0000 V to 3.6000 V and −1.8000 V to +1.8000 V corresponding to 0.00° to 360.00° and −180.00° to +180.00°; infinite resolution.			
DC Offset	None			Continuously adjustable angle offset. Analog panel meter and DC output indicate deviation from offset.

OPTIONS

#101 Rear connectors for signal and reference inputs, BNC[4]

#102 Full mainframe programmability; includes self check, angle range and time constant selection, DTL and TTL compatible.

#103 High speed analog output response. Time to respond to within 99% of step change: 1 ms for frequency >5 kHz, 10 ms >500 Hz, 100 ms >50 Hz, 1 second >5 Hz. (Temp. stability ±0.01°/°C)

(Opt. 103 not available with Opt. 107 or Mod. 14 below.)

#105 Remote zero control.

#107 Automatic calibration checks and automatically readjusts digital readout and BCD output circuits to reduce readout errors to ±0.02°. This option available only on 305C.

#110 Full compatibility with IEEE 488 Interface Bus. (Requires options 102 and 305-PA-3007 Plug-In.) This option available only on 305C.

Mod. 14 Higher accuracy below 12 Hz. Available only on 305B, 305C, and 305D.

COMBINED PLUG-IN AND MAINFRAME SPECIFICATIONS

MODEL	FREQUENCY RANGE	INPUT LEVELS (independent)	INPUT Z	ACCURACY[2] WITH INDEPENDENT LEVELS UNLESS OTHERWISE INDICATED Analog output accuracy: As specified below. Digital phase accuracy: For model 305C, same as analog accuracy. For model 305B, add ±0.15° digital readout error to analog accuracy specified.
305-PA-3001 Auto Ranging Plug-in	2 Hz to 700 kHz	10 mV to 300 V rms up to 10 kHz and to 50 V rms up to 700 kHz; can be extended to 40 kV rms with Tektronix probes. Each channel has automatic gain ranging, and lamps which indicate when level is below 50 mV and above 50 V rms.	1 megohm shunted with 40 pF	±0.05°, 50 mV to 50 V rms from 50 Hz to 50 kHz; typically ±0.03°, 50 mV to 50 V rms from 50 Hz to 50 kHz, ±0.05° to 10 Hz, ±0.1° to 250 kHz, and ±0.25° at other levels to 500 kHz.
305-PA-3002 Single Range Plug-in	2 Hz to 700 kHz	10 mV to 3 V rms[1]; can be extended to 3 kV rms with Tektronix probes. Other ranges available on request.	1 megohm shunted with 40 pF	±0.05°, 50 mV to 500 mV rms from 50 Hz to 50 kHz; typically ±0.03°, 50 mV to 500 mV rms from 50 Hz to 50 kHz, ±0.05° to 10 Hz, ±0.1° to 250 kHz, and ±0.25° at other levels to 500 kHz.
305-PA-3005 High Frequency Plug-in	200 kHz to 11 MHz	1 mV to 3 V rms; manual level controls in 10 dB steps. Lamps indicate when inputs are out of range or when level controls are improperly set.	50 ohms	Broadband with equal inputs above 10 mV rms: ±0.4° from 200 kHz to 4 MHz; ±1° from 4 MHz to 11 MHz. With independent levels above 10 mV rms: ±1° up to 4 MHz and ±2° up to 11 MHz. Single frequency — above 10 mV rms: ±0.3° at any frequency from 200 kHz to 11 MHz at any fixed levels.
305-PA-3007 Programmable and Auto-Ranging Plug-in	2 Hz to 700 kHz	Autoranging: similar to levels of 305-PA-3001. Programmable: overrides autoranging; extends low levels to 1 mV rms; DTL, TTL logic; program connector in rear of mainframe.	1 megohm shunted with 40 pF	Same as 305-PA-3001 for levels above 10 mV rms; typically ±0.35° from 50 Hz to 50 kHz for levels below 10 mV rms.
305-PA-3008 Power Freq. Plug-in	50-500 Hz without filters. 50 Hz, 60 Hz and 400 Hz L.P. filters available[3]	25 V to 250 V rms; 0.1 A to 5 A rms. Inputs are transformer isolated.	100 k ohm (voltage) 0.02 Ω max. (current)	At any single frequency, with filter set: ±0.1°, 25 V to 250 V rms, or 0.1 A to 5 A rms.
305-PA-3009 Network Analyzer (Gain/Phase/ Amplitude)	5 Hz to 700 kHz (Note: 305-PA-3009A operates to 1 Hz with 305 mod. 14)	10 mV to 40 V rms. Each channel has automatic gain ranging. Direct reading of phase angle, amplitude ratio and level of each input. Compatible with Tektronix probes.	1 megohm shunted with 40 pF	Phase: ±0.1° from 40 mV to 40 V rms from 50 Hz to 50 kHz; typically ±0.25° at all other levels from 5 Hz to 500 kHz. Voltage Amplitude: above 40 mV (channel A or B): ±2% reading ±0.03% FS, 50 Hz to 50 kHz; ±5% reading ±0.03% FS, 100 kHz to 500 kHz.[5] Ratio: ±0.5 dB, 50 Hz to 50 kHz; ±1 dB, 50 kHz to 500 kHz.[5]
305-PA 3010 Special Purpose Plug-in (with filter)	For use at 125 ±10 Hz; matched filters in both channels reject higher frequencies	500 mV to 5 V rms. Other ranges available on request.	1 megohm shunted with 40 pF	±0.1°, 500 mV to 5V rms; ±0.25°, 100 mV to 500 mV rms.
305-PA-3015 Selectable Filter Plug-in	5 Hz to 500 kHz without filters; uses 2 of type 305-PA-3008-( ) filters [3]; filter selection programmable	Ranges of 50-500 mV rms, 0.5 to 5 V rms, and 5-50 V rms selectable by remote contact closures.	1 megohm shunted with 40 pF	With filters, ±0.1° at fixed frequencies over all levels; without filters ±0.1° from 50 Hz to 50 kHz at all levels (typically ±0.03°), typically ±.25°, 5 Hz to 500 kHz.

[1] Can be provided for other voltage levels.

[2] For sinusoidal signal; can be used for square wave inputs over limited frequency range; can be used for amplitude modulated signals up to 97% modulation, depending upon model, level and frequency.

[3] 50 Hz filter, P/N 305-PA-3008-50; 60 Hz filter, P/N 305-PA-3008-60; 400 Hz filter. P/N 305-PA-3008-400. (Other frequencies available on request.)

[4] Available for use with 305-PA-3001, -3002, -3007 and -3010. Specify when ordering plug-in. [5] For higher accuracy below 50 Hz, specify Model 305-PA-3009A.

DRANETZ

SERIES 331

HIGH ACCURACY ECONOMY PHASEMETERS

- Accuracy to 0.05°, resolution to 0.01°
- Frequency range 5 Hz to 500 kHz
- Analog output and 4 or 5 digit panel readouts
- Input 0.05 to 220 V rms
- Accepts sine, square and other waveforms in either channel

The Dranetz 331 Series Phasemeters feature high accuracy over a broad amplitude and frequency range. Front panel controls (equipped with LO HI indicators) are used to select proper voltage ranges, as well as to check and adjust calibration. The 331 incorporates several of the important features of the Superperformance 305 Series, including elimination of 0° 360° ambiguity and reduction of sensitivity to noise and even harmonics. The 331 is designed for calibrating equipment, for testing subassemblies and for general laboratory work.

SPECIFICATIONS

CHARACTERISTICS	331B	331C
Frequency Range:	5 Hz to 500 kHz	
Accuracy: Sine Wave:	±0.1° ±1 digit from 50 Hz to 50 kHz, add ±0.2° per 100 kHz above 100 kHz and ±0.2° ±1 digit at 5 Hz.	±0.05° from 50 Hz to 50 kHz; ±0.2° from 10 Hz to 100 kHz; add ±0.2° per 100 kHz above 100 kHz.
Square Wave:	±0.1° ±1 digit from 10 Hz to 20 kHz; ±.5° per 100 kHz above 20 kHz	±0.05° from 10 Hz to 5 kHz; ±0.1° to 20 kHz; ±0.5° per 100 kHz above 20 kHz.
Angle Ranges:	000.0° to 360.0° or −180.0° to +180.0° automatic or selectable.	
Input Signal Amplitudes:	0.05 to 220 Volts rms in 3 ranges (0.05-0.5, 0.4-5, 4-220; can be extended with Tektronix probes.	
Input Impedance:	1 megohm shunted by 50 pF nominal	
Analog Output:	0.0000 to 3.600 V and −1.8000 to +1.8000 V DC, +10.00 mV DC/degree phase; output impedance less than 100 ohms.	
Ambient Temperature	0°C to 45°C	
Panel Controls and Adjustments:	3 range input level pushbuttons each channel; read-hold; power; 0° cal and 360° cal adjustments.	
Power Requirements:	105-125 or 210-250 volts, 50/60 Hz, 70 watts.	
Dimensions:	3½" high x 16" deep, 19" rack/portable package; 22½" x 22½" x 6½" shipping; 18 lbs. (7 kg) net wt., 25 lbs. (10 kg) shipping.	
Option:	#101: BCD output, TTL/DTL, 8421 — #102: Rack Mount	#101: BCD output, TTL/DTL, 8421 — #102: Rack Mount

FOR FULL INFORMATION AND DETAILED SPECIFICATIONS WRITE FOR BULLETIN 331

TR-2004 — TR-2005 CURRENT TRANSFORMERS

FEATURES

- Output voltage is faithful reproduction of input current
- Wide frequency and dynamic range
- Excellent pulse and phase response
- High voltage isolation
- 1¼" D hole for primary

APPLICATIONS

- Testing sonar projectors and arrays
- High power immitance and transfer measurements
- Measuring transients in SCR's
- Measuring electron beam currents
- Current sensing in AC feedback systems

SPECIFICATIONS

CHARACTERISTIC	TR 2004	TR 2005
Sensitivity per Primary Turn (V rms/A rms)	0.1; +0, −1%	1.0; +0, −1%
Square Pulse Input		
Max. Current	10,000 A pk	1,000 A pk
Rise Time	For rise times > 1 microsec.	40 nanosec. approx.
Droop	10^{-4}%/microsec.	10^{-2}%/microsec.
Max. Amp-sec. per pulse	1	0.1
For Sinusoidal Input		
Amplitude Limit	100 A rms above 17 Hz; 9 A pk/Hz below 17 Hz; 90 A pk at 10 Hz	10 A rms above 100 Hz; 0.15 A pk/Hz below 100 Hz; 7.5 A pk at 50 Hz
Useful Frequency Range	0.25 Hz to 700 kHz	20 Hz to 10 MHz
Amplitude Response with Frequency +0%, −1% Limits		
Low Frequencies	4 Hz to 100 kHz	1 kHz to 4 MHz
	3 dB at 0.25 Hz	3 dB at 20 Hz; −3% at 200 Hz; −5% at 100 Hz
High Frequencies	3 dB up to 700 kHz; +2.5% at 300 kHz; +7% at 400 kHz	3 dB at 10 MHz
Phase Response ±0.8° Limit	20 Hz to 100 kHz	1 kHz to 2 MHz
Low Frequencies	1.5° at 10 Hz; 2.9° at 5 Hz	2° at 500 Hz; 4° at 250 Hz; 8° at 100 Hz; 13° at 50 Hz
High Frequencies	1.5° at 200 kHz; 2.2° at 300 kHz	2.7° at 5 MHz
Electrostatic Shielding	10^{-4} ampere turns through primary	10^{-5} ampere turns through primary
With 1000 volts rms at 5 kHz on primary, secondary output corresponds to less than:		
Maximum Insertion Impedance	0.0002 ohms	0.02 ohms
Maximum Voltage	15 kV pk surface to high voltage; 30 kV pk with primary insulation	
Typical Primary Capacitance	6 pF in oil; 3 pF in air	
Recommended Load	> 10,000 Ω in parallel with < 20 pF	
Dimensions	(approx) 5" OD x 1¼" ID x 2½" high plus mounting flange (4 mounting holes on flange: 3/16" D on centers 1 5/16" x 2½")	
Connector	BNC	
Weight	4 pounds approx.	
Shipping Weight	8 pounds approx.	

DRANETZ

SERIES 325

POWER SYSTEM POLYMETER / DUAL MEASUREMENT OF VOLTAGE, CURRENT, TIME, FREQUENCY

FEATURES

- Simultaneous measurement and display of two selectable parameters.
- Display of continuous, triggered or maximum readings.
- Full isolation of all inputs.
- Precision measurement of time interval in seconds or cycles.
- Large 0.6" digital display.
- Precision frequency measurement optional.
- Portable for field use.
- A field instrument with laboratory accuracy.

The Series 325 is specifically designed for measuring key parameters in electric power systems. Simultaneous measurements of Voltage and Current, 2 Currents, 2 Voltages, Current and Time, and Voltage and Time may be made. Readings may be taken on a continuous basis, or the meter may be triggered to "freeze" readings at a specific time. Time may be measured either in seconds or cycles of the power line frequency. Timing and trigger inputs may be actuated from type A or B dry contacts or by AC or DC voltages. Special circuits assure positive triggering on first contact and prevent simultaneous start/stop conditions. Options and adapters are available for DC current, DC voltage, fast frequency measurement, low pass filters and BCD outputs.

APPLICATIONS

Ideal for electric utility use.
Testing of trip points on overcurrent, overvoltage, undercurrent, undervoltage, and underfrequency relays.
With Model 314 Phase Angle Meter, ideal for impedance relays.
Precision measurement of frequency.

SPECIFICATIONS

Frequency Range: 47-450 Hz. (25 Hz available on request.)
AC Voltage: 15 mV to 1000 V RMS, 1.5, 15, 150, 600 V FS, transformer isolated, 5000 ohms per volt.
AC Current: 1.5 mA to 100 A RMS, 0.15, 1.5, 15, 100 A FS, transformer isolated, .001 ohms insertion resistance.
Time Interval (2 ranges): 0 to 999.99 seconds in .001 second increments. 0 to 9999.9 cycles in 0.1 cycle increments.
Trigger Inputs: (Start and Stop) Contact closure, DC step voltage change, or AC input.
Accuracies: V, I, for 57-63 Hz ±0.25% reading ±0.025% FS, for 25-450 Hz ±0.4% reading ±0.04% FS; Time, ±0.003% reading ± last digit.
Out of Range: Display blinks when level is too high.
Measurement Modes: Continuous, triggered, and "hold maximum."
Dielectric Test: 4250 V RMS to ground from V and I terminals. 1600 V RMS to ground from trigger terminals. (Per ANSI-C39.5.) Also meets SWC test.
Power Supply: 95 to 140 or 190 to 280 V RMS, 47 to 450 Hz, 20 watts, International Universal type connector.
Operating Temp. Range: 10°F. to 110°F.
Size: Portable, weatherproof, with cover 11" L x 7" W x 9½" D; without cover 11" L x 7" W x 7" D (Panel 11" x 7"); shipping 11" x 14" x 18".
Weight: 10 lbs. (5 kg.); shipping 17 lbs. (8 kg.).

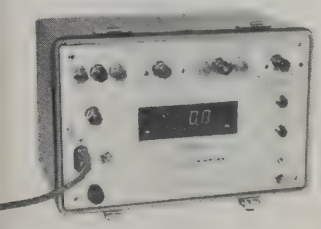
OPTIONAL FEATURES

Option 101: Fast frequency measurement capability — 0.1 sec. meas. time, 0.01 Hz resolution; 1 sec., .001 Hz resolution; accuracy ±0.002 Hz ± resolution.
Option Set 102 and 105: True RMS detection and low pass filters for removing effects of harmonics from measurements.
Option 103: BCD outputs suitable for driving printers for recording measured data. DTL/TTL compatible.
Option 107: Panel mount with remote display.
Option Set 108 and 109: Dry contacts corresponding to START/STOP times and accessory power for 325-PA-( ) adapters.
325-PA-1001: DC Current Adapter.
325-PA-1002: DC Voltage Adapter.
325-PA-1003: Contact Opening Trigger Adapter.
MR16-2 Rack Mount: 19" rack plate and dust cover.

FOR FULL INFORMATION AND DETAILED SPECIFICATIONS WRITE FOR BULLETIN 325

SERIES 314

POWER SYSTEM PHASE ANGLE METER / FOR ACCURATE & RAPID MEASUREMENT OF PHASE ANGLE IN ELECTRIC POWER SYSTEMS



FEATURES

- Universal Current-Voltage Inputs, V-V, I-I, V-I
- Portable
- Immune to Harmonics
- Independent of Frequency Changes
- Digital Readout — "No Hands" Simplicity
- Accuracy ±0.5°, Resolution ±0.1°
- Independent of Input Levels
- Complete input isolation

APPLICATIONS

- Testing and Adjustment of Protective Relays
- Measuring Load Current Phase Angles—Measuring Power Factor
- Testing Polyphase Balance
- Determining Power Flow in Interconnected Systems
- Minimizing Circulating Reactive Currents
- Synchronizing Multiple Sources

Accurate, precise and rapid phase measurement is an essential technique in the setup, operation, and maintenance of modern power systems, subsystems, and the control and protection circuits used in them. The value of a phase meter in such applications is directly proportional to the speed, convenience, and validity with which it indicates the phase angles it measures. With the introduction of the Dranetz Model 314, virtually all of the limitations and error sources of electromechanical meters have been removed, and the overall accuracy of this class of phase measurements has been increased by more than a full order of magnitude. The basic accuracy of ±0.5° specified for the Model 314 is actually **maintained, without degradation,** over the wide ranges of frequency variation, voltage/current level, and harmonic content for which the instrument is rated. Furthermore, the direct-reading **digital** presentation of phase, to four-place resolution (0.1° increments) requires no interpretation or interpolation, and is not subject to reading errors or parallax. **The phase angle you see is the phase angle that exists — to within ±0.5°,** without correction or uncertainty.

SPECIFICATIONS

ELECTRICAL

Range: 000.0° to 360.0°, Direct-reading
Frequency Range: 47-53, 57-63 Hz (specify at time of ordering)
Input Current Range: (both input circuits) .015-50 A rms
Input Voltage Range: (both input circuits) 0.3 to 600 V rms
Current-Input Impedance: Approx. 2 or 20 milliohms
Display: Four digits, non-flickering, 0.6" numerals
Resolution: 0.1°
Accuracy: ±0.5°
Burden:
Voltage: 1.8 VA max. at 600 V rms input
Current: Approx. 2.5 VA at 50 A rms input
Interaction Between Inputs: None
Errors Due to Harmonic Distortion: None for harmonic distortion up to 30%, any harmonic
Errors Due to Offground Inputs or Reversal: None
Overload:
Voltage: 100% overload for 1 minute
Current: 100 A rms for 1 minute
Dielectric Test: Up to 2200 Volts rms between inputs and ground (ANSI-C39.5)
Self-Check: Provided for 000.0°. Full scale (360.0°) is autocalibrated internally
Power Required: 115/230 V, 50-60 Hz, 20 Watts

MECHANICAL AND ENVIRONMENTAL

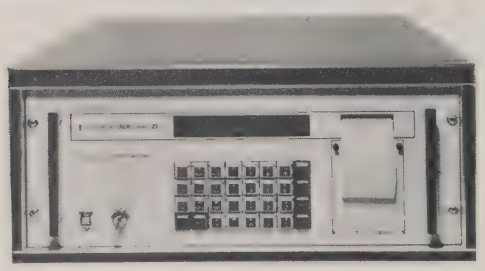
Size: Portable, weatherproof carrying case with cover 11" L x 7" W x 9½" D; without cover 11" L x 7" W x 7" D (Panel 11" x 7"); shipping 11" x 14" x 18".
MR16-1 Rack Mount (optional): 19" rack plate and dust cover.
Operating Temperature Range: 10°F to 110°F.
Weight: 10 lbs. (5 kg.); shipping 17 lbs. (8 kg.).

FOR FULL INFORMATION AND DETAILED SPECIFICATIONS WRITE FOR BULLETIN 314

DRANETZ

SER SYSTEM 22

SEQUENCE OF EVENTS RECORDER



Ruggedly built for the power industry. Documents the activity of relays in substations, power generating stations, or industrial process control systems. Each input circuit senses a contact opening or closure. When such an event occurs, the time, state (alarm or normal), input number, and a user programmed alpha input description are printed. This data may be transmitted to a remote printer, supervisory control, or CRT via the recorder's RS232C interface.

The following printout is typical of information that is recorded immediately after a relay state change is detected.

Time of trip HRS:MIN: SEC:MSEC	*Current Status*	*Input #*	*Alphanumeric Description of Input*
17:02:45:020	*ALARM*	*0107*	*OC RELAY LINE 2*
	ALARM	*0050*	*DIST RELAY LINE 4*
17:02:45:021	*NORM*	*0711*	*BREAKER #1 LINE 1*

APPLICATIONS

- Aids in diagnosing system faults
- Pinpoints malfunctioning equipment in substations or power generating stations
- Portable unit allows the sequence testing of newly installed relay systems
- Provides operating personnel with an instantaneous indication of changes in system status

FEATURES

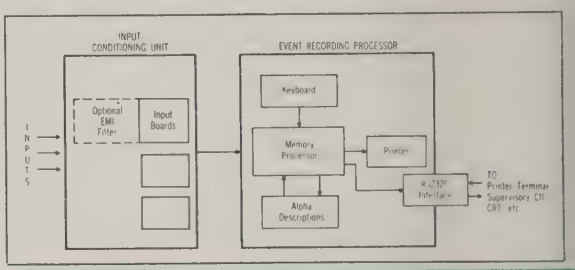
- 1 msec resolution • 32-1024 input capability
- Ongoing self-diagnostics — detailed diagnostic output
- Modular design • High noise immunity
- Instantly programmable solid state alpha description memory
- Portable or permanent installation
- Remote programmability
- RS232 interface permits transmission of output to remote printer, supervisory control, CRT, or annunciator

SYSTEM CONFIGURATION

The single panel Event Processor/Terminal (7" H x 19" W x 22" D) contains the processor, event and input description memory, power supplies and up to 32 input points. With the integral printer and keyboard-display option,you truly have a portable sequence of events recorder.

The system may be expanded through the addition of Input Conditioning Units (7" H x 19" W x 22" D) containing up to 64 inputs per panel (8 inputs/board with 8 boards/panel). A fully expanded system includes 16 additional input panels, for a total of 1024 inputs.

Two printer options are available. Model 2210PT incorporates an integral printer keyboard-display package. Model 2210P utilizes a separate terminal.



SPECIFICATION SUMMARY

System Power — 120 VAC primary power source. Automatic bumpless transfer to 125 VDC standard to insure continuous operation.

Inputs — Dry contact either normally open or normally closed programmable on a point by point basis. 1024 inputs maximum.

Input Boards — Input boards accept 8 inputs. Each input circuit provides optical coupling and analog/digital filtering of the input signal, 8 input boards plug into a 19" Input Conditioning Unit. Input boards are available for field contact voltages in the following ranges: 10-24 VDC, 40-90 VDC, 85-125 VDC, and 120-155 VDC.

Field Contact Voltage — Power may be supplied by the system's own optional power supply or by a user source such as the user's station batteries.

Resolution — 1 millisecond for up to 512 inputs and 2 milliseconds for up to 1024 inputs. For a 512 input system, events occurring more than 1 millisecond apart will be listed in the order in which they occurred with their event time to the millisecond. Events that occur within a millisecond duration will be considered to have occurred simultaneously.

Contact Bounce — 4, 8, 16, 32, 128, and 256 millisecond delays are available to eliminate multiple printouts due to contact bouncing. Delays are field selectable using a single jumper for the entire system.

Clock — Phase locked to line frequency with automatic transfer to crystal oscillator when voltage drops below 100 volts. Will synchronize to external pulse such as WWV. Pulse will be suppressed when events are in memory in order not to disturb the relative time differences between events in memory and events which may be occurring. If the unit contains the front panel printer, keyboard, and display, time will be continuously shown on the display unless the unit is being programmed.

Printer — Two standard printers are available, a free standing Dot Matrix Printer, and a thermal printer keyboard display combination located on the front of the Event Processor/Terminal. Printers are operative only when event information is being printed. A message is printed when paper is low. Return to normal messages may be suppressed. An inhibit print function allows events to be processed and retained in memory while paper is being replaced or printer is being repaired.

Event Memory — At least 113 levels of event memory is standard, expandable to 339 levels. This is a "worst case" value based upon one input per board changing state. Multiple inputs changing state on the same board within the same millisecond will use only one level of memory.

Alphanumeric Input Descriptions — 8, 16, 32 character alpha descriptions are available. Descriptions are stored on boards containing non-volatile, electrically alterable read only memory chips. Alpha capability may be added or expanded in the field. If the recorder is to be moved between two stations, a separate alpha description board can be programmed and plugged in when needed. Descriptions are input through the printer keyboard in an interactive mode with the recorder's processor. In the event the alpha board is inoperative, the numeric event data will still be printed.

Noise Immunity — Extensive analog and digital filtering, and shielding have been designed into both the Event Processor and Input Conditioning Units to attenuate conducted and radiated noise. An optional EMI filter board connected to the front end of an input board may be used in extra-ordinary high noise environments.

System Diagnostics — Ongoing self-diagnostics. The unit tests the majority of its hardware on an ongoing basis. Should a malfunctioning component be found, a descriptive message will be displayed and in some cases, the unit will take corrective action (i.e., if a defective input board is downgrading the performance of the system, it will be internally disconnected).

An optional ground fault detector — Trips on 5 mA to ground on either side of the power supply. An optional bank of switches isolates inputs, in groups of 32, to aid in determining which input is causing the ground fault.

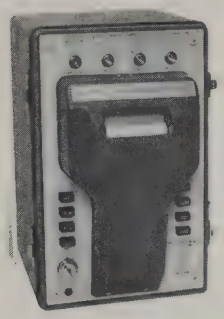
Single point test — The state of a designated input is changed, forcing the system to process an event. If the system finds it cannot process the event properly, a message is printed. This test may be programmed to occur hourly, daily, or may be initiated manually.

24 hour printout — At midnight, the system will update the time and date and print out a summary of inputs that are currently in alarm.

DRANETZ

SERIES 606*

POWER LINE DISTURBANCE ANALYZER/RECORDER



- For 115/230/460 V rms, 1 and 3 phase systems.
- Monitors, classifies, times and prints out line disturbances.
- Immediate and day-end printouts.
- Operates on command or disturbance — no wasted paper.
- For portable or permanent installation.
- 4 hour internal carry over power.

The 606 is designed specifically for monitoring power lines connected to computers, process control systems, hospital equipment and data communications devices, which are particularly susceptible to line transients, level changes or other disturbances. Using a digital microprocessor, the 606 classifies each disturbance into IMPULSE, CYCLE-TO-CYCLE CHANGE or SLOW RMS CHANGE. When preset thresholds are exceeded, the instrument prints out time, classification, magnitude, duration and channel designation. Data is also accumulated for overflow and day-end printout. The instrument is designed for unattended monitoring in a permanent installation or for temporary use at more than one site.

SPECIFICATIONS

Input Voltage Ranges: 115, 230, 460 V rms ±50%, all transformer isolated, Zin > 100 kΩ

Number of Inputs: Model 606-1, 1 input; Model 606-3, 3 inputs (3φ or separate circuits)

Test Modes:

AVG+ or AVG−: Increase or decrease in steady state rms, averaged over 10 sec

SURGE or SAG: Increase or decrease in cycle-to-cycle rms value

IMPULSE: 0-peak value of impulse (excluding line voltage waveform) having duration 0.5-800 μsec. Optional Adaptors (see below) measure strength, polarity and direction.

ACCUMULATED COUNT: Summation of disturbance data in memory (includes time, HI AVERAGE, LO AVERAGE, HI SURGE and number of HITS, LO SAG and number of HITS, HI IMPULSE and number of HITS)

Printing Modes:

AVG+ or AVG−: Prints time, AVG+ or AVG−, rms VALUE, CHAN., when exceeding threshold of 3, 5, 10, 15 V rms*

SURGE or SAG: Prints time, SURGE or SAG, rms VALUE, CHAN. and duration (cycles) when exceeding threshold of 3, 5, 10, 15 V rms*

IMPULSE: Prints time, IMPULSE, 0-pk VALUE (excluding line voltage) and CHAN, when exceeding 0-pk threshold of 50, 100, 200, 400 V. See below for additional information printed when Impulse Analysis Adaptors are used.

SUPPLY DOWN or UP: Prints POWER OFF or POWER ON and TIME

STORED DISTURBANCES: Stores data on disturbances during printing. Prints out when printer clears

ACCUMULATED COUNT (Short Term): Overflow of data entering printer. Prints out automatically

DAILY ACCUMULATED COUNT: End-of-day print out. Prints number of day and ACCUMULATED COUNT

TEST: Prints time and ACCUMULATED COUNT

RESET: Prints time and ACCUMULATED COUNT, resets memory

PRINT OFF: Prints PRINT OFF and TIME, disables printer, all data goes into accumulator for delayed summary printout

Accuracy:

AVG+ or AVG−: At 60 Hz (sine wave signal), ±1% of reading ±1% of nominal input

SURGE or SAG: At 60 Hz (sine wave signal), ±1% of reading ±1% of nominal input

IMPULSE: ±5% of reading ±1% of maximum impulse calibrated with a positive going, 10 μsec, half sinewave impulse. 6 dB bandwidth with half sinewave impulses: 800 μsec to 0.5 μsec

Clock: Indicates real time in hours, minutes, seconds, crystal controlled. During power off, operates on internal batteries (4 hours). Clock resets from front panel buttons

Printer: 18 character, alpha-numeric, thermal, paper 2¼″ wide, prints 1 line/sec

Supply Power: 90 to 140 V rms, 45-450 Hz, 1φ, 1.0 A maximum (also DC operation 120-170 V maximum).

Case: Portable, removable cover with carrying handle.

Size (with cover): 11″ H x 7″ W x 9½″ D; shipping 11″ x 14″ x 18″.

Weight: 16 lbs. (7 kg.); shipping 24 lbs. (11 kg.).

Options: Opt. 101 (606-3 only), freq. disturbances; Opt. 102, 115/230 V supply power (switch selectable), 45-65 Hz; Opt. 103 (606-3, Opt. 101 only), monitors 400 Hz power lines; Opt. 104, external event indication; Opt. 105, enables use of Impulse Analysis Adaptors; MR15 Rack Mount Series, 19″ rack plate and dust cover.

Model K103 Test Kit: Includes disturbance generator designed to verify operation of Series 606. Also includes a card puller, an extender card, and a set of programmed memories for assisting in calibration and troubleshooting.

Model 910 Uninterruptible Power Supply: For complete operation of 606 during power shutdown up to 2 hours. Fully protected from impulses to 1600 Volts, sags and surges of 50%, and total power interruptions.

Input (under normal conditions): 115/230 V rms nominal (switch selectable), 45-65 Hz, 1φ, 1.0 A maximum.

Output: 120 to 170 Volts, DC, 1.0 A.

Recharging Time: 18 hours.

Size: Portable carrying case same size as 606.

Weight: 35 pounds (16 kg.).

*These values for 115 V input; multiply by x2 or x4 for 230 V rms or 460 V rms.

SERIES 606-PA-(600X)*

IMPULSE ANALYSIS ADAPTERS FOR SERIES 606

Impulse Analysis Adapters supplement the analytical capabilities of the Series 606 Power Line Disturbance Analyzers by providing recorded measurements of **impulse strength,** i.e., the integral of impulse voltage with respect to time. The **strength** indicates the potential of the disturbance to damage or interfere with **sensitive** electronic equipment. Two of the four models in the Series also provide indication of the Polarity and Direction, i.e., from source to load or vice versa. These data are conveyed to the associated Model 606 (equipped with Option 105), for printing in conjunction with the information provided by the Model 606 itself.

* Manufactured under U.S. Pat. Nos. 3,549,874; 4,187,461; 4,206,413

SPECIFICATIONS

Function

606-PA-6001 Single-phase, 50/60 Hz; measures Strength only.
606-PA-6002 Three-phase, 50/60 Hz; measures Strength only.
606-PA-6003 Single-phase, 50/60 Hz; measures Strength, Polarity and Direction. Includes one current probe.
606-PA-6004 Three-phase, 50/60 Hz; measures Strength, Polarity and Direction. Includes three current probes.

Printed Information

Strength: Separates IMPULSE disturbances into six ranges of Strength. Prints appropriate range, i.e., >.001 V-SEC.
Polarity: Prints + or −.
Direction: Prints SRCE or LOAD.

Input Voltage Ranges: Same as Series 606.

Input Current Ranges: (Only applies to -6003 and -6004).

Max. at power-line frequency (47-63 Hz):	100 A. rms
Max. Impulse:	1000 A. Peak at 1 msec
Min. for Direction determination:	1 A. for at least 0.2 μsec

Current Probe Insertion Impedance: 0.4 mΩ at 60 Hz.

Steady State Power Requirements: Single-phase Adapters operate from power supply of associated Model 606. Three-phase Adaptors contain a separate power supply which requires 90 to 140 Vrms, 45 to 65 Hz, 1φ, at 0.25 A. nominal.

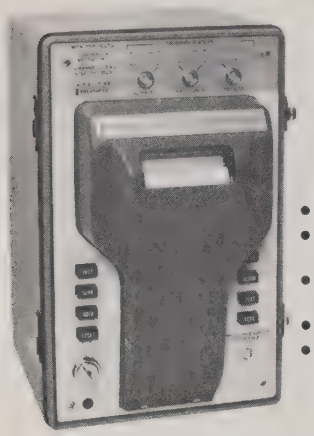
Option 102: Available on -6002 and -6004 to permit operation from 180 to 280 Vrms, or 90 to 140 Vrms (switch-selectable), 45-65 Hz, 1φ.

FOR FULL INFORMATION WRITE FOR BULLETIN 606

DRANETZ

SERIES 616*

DC/AC VOLTAGE DISTURBANCE ANALYZER



- Field troubleshooting
- Power supply analysis and testing
- Testing power conditioning equipment
- Monitoring battery voltages
- Simultaneous monitoring of AC and DC voltages

The Series 616 is a highly portable easy-to-connect analyzer for recording voltage disturbances on three channels: one AC and two DC. The Series 616 combines the outstanding features and operating techniques of the Series 606 (described on previous page) to record IMPULSES, SAGS and SURGES, and SLOW AVERAGE variations, when they occur, in an easy-to-interpret alphanumeric printout. The instrument is ideal for pinpointing the effects of AC input line disturbances on the DC outputs of power supplies in computers, communication equipment, and medical apparatus. Two models, the Model 616A for 4 to 25 VDC and the Model 616B for 8 to 50 VDC, are available.

* Manufactured under U.S. Pat. Nos. 3,549,874; 4,187,461; 4,206,413

SPECIFICATIONS

Input Voltage Ranges:* Channel A, 40 to 250 Vrms, 45 to 65 Hz; Channels B&C, ±4 to 25 VDC.

Test Modes

Impulse: Peak voltage of impulse after removing steady-state AC or DC voltage level. Impulse durations range from 0.5 to 800 μsec.

Sag/Surge: Sudden changes in steady-state voltage. Measurement interval equals one cycle of Channel A signal.

Slow Average: Slow changes in steady-state voltage. Measurement time constant is approximately 5 seconds.

Accumulated Count: Summation of disturbance data in memory (includes the number and worst case values of each type of disturbance on each channel since the beginning of the day).

Printing Modes

Impulse: Prints time, IMPULSE, 0-pk. value (excluding steady-state) and channel, when exceeding 0-pk. thresholds of 0.5, 1.0, 2.0 and 4.0 V* for DC channels, and thresholds of 50, 100, 200, 400 V* for AC channel.

Sag/Surge: Prints time, SURGE or SAG, voltage, duration (cycles) and channel when exceeding thresholds of 0.3, 0.5, 1.0, 1.5 V* for DC channels, and thresholds of 3, 5, 10, 15 Vrms* for AC channels.

Slow Average: Prints time, AVG+ or AVG−, voltage, and channel when exceeding thresholds of 0.3, 0.5, 1.0, 1.5 V* for DC channels, and thresholds of 3, 5, 10, 15 Vrms* for AC channel.

Supply Power: 90 to 140 Vrms, 45 to 65 Hz, 1φ, 1.0 A. maximum (also DC operation from 120 to 170 V).

Options: Opt. 101, frequency disturbances on channel A; Opt. 102, 115/230 V supply power (switch-selectable), 45 to 65 Hz; Opt. 104, external event indication; MR15 Rack Mount Series, 19″ rack plate and dust cover.

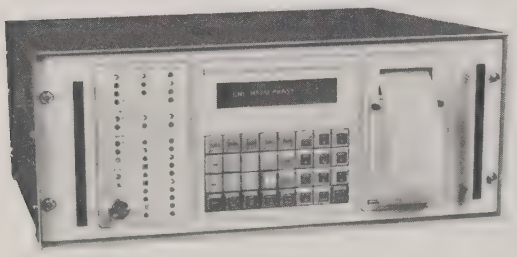
Model 604A-PA-1001: Adapts the Model K103 (described on previous page) for troubleshooting and calibration of the Series 616.

*These values are for Model 616A. Multiply by 2 for Model 616B.

FOR FULL INFORMATION WRITE FOR BULLETIN 616

MODEL 3100

SAMPLING NETWORK ANALYZER



FEATURES

- Measures Complex V, I, Ratio, Phase Angle and Power.
- Computes all Parameters Individually to 14th Harmonic.
- 1 Hz to 500 kHz.
- 1 mV to 300V Full Scale Ranges.
- Computes Magnitude/Phase or Real/Imaginary (Quadrature).
- High Accuracy: ±0.05% F.S., ±0.05% R, ±0.03°.
- Acquisition Time Down to One Cycle.
- Dual Channel with Auto-Ranging.
- RS-232C Interface Standard.
- IEEE-488 Bus Interface Available.

APPLICATIONS

Applications for the 3100 will be found where high precision phase, power and ratio measurements in the presence of high harmonic content, are common. The wide 70 dB dynamic range of the instrument, plus the high level of stability and reliability with state-of-the-art accuracy, make the 3100 truly unique in the network measurement world.

Aircraft, aerospace, and electronics applications are numerous. The 3100 provides a new accuracy dimension for ATE and GSE consoles, test set-ups for analog board testing, module and subsystem testing, vibration analyzers, and circuit and network analysis:

- Ground Support and Equipment Test
- Precision Power & Harmonics Analysis Measurements
- Vibration Analysis
- Communications Network Testing
- Sonar Pulse Testing
- AC Coupled Transfer Function Analysis
- Servo and Synchro Measurements
- R L C Measurements
- Line Fault Analysis
- ATE Consoles
- Filter Tests
- Amplifier Tests
- Oscillator and Crystal Testing

FOR FULL INFORMATION WRITE FOR BULLETIN 3100

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FREE TECHNICAL ARTICLES

Prepared by the Engineering Department of Dranetz Engineering Laboratories

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TM-102,991	When & How to Automate Phase Instrumentation (12-page technical paper).
TP-102,980	Phasemeter Specs Can Fool You (6-page reprint from **Electronic Design**, November 22, 1975).
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TP-102,998	Input-Output Disturbance Analysis — A New Technique for Power-Supply Performance Evaluation (6-page technical paper presented at Powercon 4, May 13, 1977).
TP-102,999	The Power Problem — A 2-page reprint from **Computer Security** (Newsletter for Computer Professionals). July/August 1979. By Stephen J. Tharp, Dranetz Engineering Laboratories, Inc. and Aileen MacGahan, Chase Manhattan Bank.
TP-103,000	Impulse Strength Measurement: A New Technique for Analyzing Power-Supply System Performance Under Actual Field Conditions. Presentation to: International Telecommunications Energy Conference, November 27, 1979. Given by: Stephen J. Tharp and Philip Cox, Dranetz Engineering Laboratories, Inc.
AR-108001	Phase Meters — Applications from the Lab to the Stars (6-page reprint from **Electronics Test**, August 1979).
AR-108004	Sequence-of-Events Recorders Pinpoint T-line Fault Causes (4-page reprint from **Electric Light & Power**, February 1980).
AR-108005	Evaluating Power Line and Power Supply Performance in Computer Systems (6-page reprint from **Digital Design**, February 1980).

THESE ARTICLES ARE AVAILABLE UPON REQUEST

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All products of Dranetz Engineering Laboratories, Inc. are warranteed to the original purchaser against defective material and workmanship for a period of one year from the date of delivery. Dranetz will repair or replace, at its option, all defective equipment returned to it, freight prepaid, during the warranty period, without charge, provided there is no evidence that the equipment has been mishandled or abused.

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